RAILROAD GAZETTE

## AMERICAN LOCOMOTIVES IN FRANCE.

About five years ago manufacturing conditions in America and Europe were such that American locomotive builders were able to sell a number of engines to European railroads. On most of the roads, the American engines were received with some prejudice, and many indefinite accusations of extravagant fuel consumption were made against them. Authoritative figures are now at hand, in the reports of tests made on the French State Railway, given elsewhere in this issue and in the issue of October 28, which satisfactorily disprove the allegations of extravagance.

The coal consumption per horse-power hour for the French and the American locomotives, as shown by the full series of tests, was as follows:

| Number of Engine. | Class. | Lbs. Coal per h.p.h'r. |
|---|---|---|
| 2754 | French single-compound .... | 4.40 |
| 2901 | American single-expansion .. | 4.45 |
| 3729 | French compound ......... | 3.24 |
| 2802 | American compound ....... | 3.30 |

Showing little difference between the French and the American engines in fuel economy. When the American locomotives were put into service in Europe, they were of a type unfamiliar to the men handling them, and they also had to contend with an unreasonable prejudice against an imported locomotive. That this handicap is not yet removed, is shown by the tone of Mr. Nadal's report. His remarks on the American locomotives are introduced as follows:

> American locomotives have the reputation of being less economical than those of Europe, and this reputation appears to be justified by the results given by those on the French State Railways, *at least when they were first put into service.*

This conveys the impression that the American locomotives are less economical than the French, but the clause which we have italicised seems to indicate pretty clearly that the American engines, being properly broken in, are giving results which are substantially equal to those obtained with the French engines. This conclusion is justified by the coal consumption just shown. Mr. Nadal's other criticisms also lack support.

The American locomotives are criticized on five points:

1. Low boiler efficiency and excessive priming. But here are the figures of coal consumption; if the American boilers are not so efficient as the French, the American cylinders must be correspondingly more efficient or it would be impossible to obtain the same fuel consumption per horse-power hour. The actual figures for fuel consumption are not given in the summary, but the water consumption per horse-power hour is given and also the amount of water evaporated per pound of coal. By dividing the former by the latter the coal per horse-power hour is obtained. The American boilers are accused of priming badly, but any boiler will prime if the water is carried too high. That some of the American boilers can be run without priming, is shown by the tests of the single-expansion engine. In indicator diagrams of these tests, the expansion line, according to Mr. Nadal's analysis, shows a leaky piston valve, but no priming. A curious feature in connection with the alleged priming of the boiler of the compound, is that in his analysis of the expansion line of the indicator diagrams, Mr. Nadal does not find any indication of excessive water in the cylinders. The expansion curve is pronounced normal, and similar to those observed with the French single-expansion engines, in which no priming was observed. The statement that priming occurred on the American engines is probably based on the apparently high evaporative duty of the coal, and on a discrepancy between the indicated steam consumption and the measured water consumption. The figures show that about 12.5 per cent. more water was measured into the tender tank than should have been evaporated by the coal or used by the cylinders. Mr. Nadal assumes that this excess water is carried away from the boiler and through the cylinders with the steam. It seems curious that this amount of water should be carried by the steam without either showing its presence on the indicator cards or being observed directly in the exhaust. The loss of the excess water can be more readily explained by supposing a leak in the feed water connections or in the tender, or even an error in calibrating the tank. If the engine really did prime as suggested, it makes the Vauclain cylinders compare very favorably with the de Glehn, since with steam containing 12.5 per cent. of moisture, there is less than 2 per cent. difference in the coal consumed per horse-power hour.

2. Boiler Leaks.—Some trouble was experienced when the boilers were first put into service, but this was not of a permanent nature and was corrected.

3. Utilization of the Steam.—Mr. Nadal says:

> The operation of the steam in the cylinders would be as economical as in European engines if running conditions would allow of . . . a cut-off at 20 or 30 per cent. of the stroke. It appears that in America it is usual to cut off at 40 or 50 per cent. This does not give sufficient expansion, and consequently the steam consumption is high.

That is to say, in America the valves are set to allow the locomotive to develop normally a larger percentage of its maximum power. In this country extreme economy of fuel is not so desirable as securing a large amount of power. The valve setting on the American engines did not result in a high steam consumption. The water consumption per horse-power hour was found from the tests to be:

| Engine No. | Class. | Lbs. Water per h.p. h'r. |
|---|---|---|
| 2754 | French single-expansion piston valve .................... | 29.80 |
| 2901 | American single-expansion piston valve ............... | 29.63 |
| 3729 | French compound .......... | 23.59 |
| 2802 | American compound ........ | 26.67 |

As previously explained, the figure for the American compound is too high, owing to water losses which are not due to the cylinders. The dry steam consumption per horse-power hour, as calculated by Mr. Nadal from the indicator diagrams, is

| | Lbs. of Dry Steam. |
|---|---|
| French compound ................ | 22.58 |
| American compound .............. | 22.33 |

These figures show the American engines to be more economical as regards the operation of the steam in the cylinders. With the American cylinder design, with large ports and ample steam passages, there is less wire-drawing than in the French engines, so that with increasing speed the loss of power is low. For example, the de Glehn compound, at 30 miles an hour, develops a tractive effort of 7,060 lbs., while at 60 miles an hour the tractive effort is only 3,640 lbs., a reduction of 48.4 per cent. The Vauclain compound under similar conditions only reduces the tractive effort 21.5 per cent., the change being from 7,160 lbs. at 30 miles an hour, to 5,620 lbs. at 60 miles an hour.

4. Leaky Slide Valves.—In the summary, the American piston valves are criticized as leaking. But in the analysis of the individual tests, Mr. Nadal says that "the Vauclain piston valve is shown to be steam tight, at least during expansion, and it is during this period that any leakage is most likely to occur." The single-expansion piston valve is shown by the diagrams to have allowed a leakage of about 6 per cent., but in spite of this, the water consumption per horse-power hour is lower than that of the French piston valve.

5. Resistance.—In the summary it is suggested that the American engines are less carefully built than the French, and that their resistance is consequently higher. There is no definite statement that this is so, but it is strongly hinted at. As before, however, the figures given fail to prove this charge. From the power developed, and from the known resistance of the train, Mr. Nadal determined for each type of locomotive a formula giving the resistance per ton of locomotive and tender in terms of the speed. These formulæ are given in Table VIII., accompanying the translation of the original articles printed in another column. One formula is used for the French and American single-expansion piston valve engines, and another formula is used for the French and American compounds, but in neither case is any difference made between the French and American engines. That is to say, the tests show that the resistance of the American engines is no higher than that of their French competitors.

The "characteristic factors" calculated by Mr. Nadal and given in Table IX. are interesting. It will be seen that when judged by these factors, the American engines stand easily ahead of the French. Compared on the basis of horse-power effective at the tender drawbar, the steam consumption is

| No. | Class. | Lbs. Steam per effective h.p. h'r. |
|---|---|---|
| 2754 | French single-expansion..... | 46.56 |
| 2901 | American single-expansion .. | 41.84 |
| 3927 | French compound ......... | 36.11 |
| 2802 | American compound ....... | 33.49 |

This steam consumption is that which will be required when the locomotives are working at their maximum normal power. During the tests the French single-expansion engine averaged 575 horse-power, or 85 per cent. of the normal power, which is 675 h.p. The competing American single-expansion did the same work, developing 575 h.p., but this is only about 63 per cent. of its normal power, and it was therefore not working under such economical conditions as its competitor. Taken as a whole, the figures obtained from the tests show that even under somewhat un-

favorable circumstances the American locomotives can compete satisfactorily with the European.

## CARS AT THE WORLD'S FAIR.*

The passenger cars at St. Louis, three trains of them, constitute the main feature of the transportation exhibit. They have the beauty that is appreciated by every visitor, and their utility is apparent to many who will pass a row of big locomotives with the carelessness of ignorance; although, of course, the engines are the main feature to all who put energy first and grace second. A superficial look at the cars discloses no marked differences between the cars of 1893 and those of to-day. Those exhibited at Chicago were large and roomy, convenient in use, and tasteful in design and ornamentation, and there was not much opportunity for further progress. Steel platforms and framing have become common, steam heating has been made more perfect, and wide vestibules are now fashionable everywhere —so much so that they frequently appear in local trains, where vestibules are something of a nuisance. Dining cars are much more numerous on American railroads, but not noticeably better. Beyond these features no important changes have been made in the 11 years since the Chicago fair.

Automatic couplers for steam-pipes and air-pipes are still too young to make much of a show. Electric lighting has been extended, but its progress is still slow. The desire to use it is persistent, however, as is manifest from the fact that every car on exhibition has lights of this kind, though most have gas fixtures also. It looks as though the next world's fair—if it doesn't come ahead of time—would see electric lights in all new passenger trains and most old ones.

The first car that the sightseer encounters is the beautiful private car shown by F. M. Hicks & Co. (described in our issue of Sept. 9, page 82, news section). After one gets over the surprise of seeing such an elegant affair from a shop supposed to deal only in second-hand wares he indulges in mild curiosity as to how any builder can afford to make such luxuries to "keep in stock." Have we already become a nation of millionaires, so that 30,000-dollar traveling dwelling houses are a regular article of everyday commerce? The fact that the custodian of this car is a young woman of engaging manners and possessing a thorough knowledge of its merits, may, however, indicate that the owners do not expect to sell it by any of the ordinary salesman's wiles!

The American Car & Foundry Company shows a complete train, baggage, mail, day cars, parlor and dining cars, built for the Missouri Pacific; and an inspection of the interiors shows the latest modes in all of the details on which designers exercise their ingenuity for the purpose of introducing a little variety where sameness is in large measure compulsory. The prevailing color scheme is mahogany, with a good deal of light to relieve its heaviness. The headlinings are light colored, a sensible idea which seems to be slowly growing in favor. In a car that is always well lighted at night this is not perhaps an important question, but if the illuminant is of poor quality or deficient in quantity, as is still the case in many places, a light colored interior materially mitigates the annoyances of the passengers who wish to read after dark; and a white reflecting surface saves gas or electric power in any event.

All of these cars have windows wide enough to cover the space of two seats, and are arched at the top. This affords on the outside a pleasant change from the unrelieved row of rectangles of the time-honored day car, but inside there is at once a suggestion of inconvenience from possible disagreement between the two passengers sitting in adjacent seats, where one wishes to have the window open and the other desires it closed. But inasmuch as the ordinary arrangement (in which each passenger's comfort depends largely on the way the passenger in front manages his window) is by no means ideal, one would hesitate to declare the new arrangement less desirable than the old. To provide for very cold weather these windows are made with two panes of glass in each sash, instead of having two sashes, as in sleeping cars. The sashes have spring lifts of course; no passenger of ordinary size could think of lifting one of them by main strength. The day cars in this train both have wash-bowls. All the cars are fitted for both electric and gas lighting ("axle light" and Pintsch). In the dining car the dining-room portion is divided into two parts, the smaller of which is called, by courtesy, a private dining-room. In conveniences this train is all that one could ask for; and in interior colors and decorations it affords a not unpleasant variation from the conventional plain-wood effects so common of late years.

The train exhibited by the Pullman Company occupies two tracks, being composed of 10 cars. Every car in this train is a model of good taste. As was said in a preceding paragraph, comparisons made now with 1893 cannot be expected to show radical changes. The best trains made then were the work of competent designers and were acknowledged to be not only pleasing and satisfactory productions, but highly creditable to their creators. The accepted canons of art are not new, and the talents of American architects, decorators and upholsterers are not exactly an "infant industry," so it is not surprising if we find nothing more beautiful to-day than was shown 11 years ago. Comparisons, however, are hardly to the point. The artistic features of this Pullman train are so uniformly excellent that the observer scarcely thinks of the other fine cars that he has seen; such others may be different, but they cannot be more chaste, or refined. Much of the inlaid wood work and of the gold and gilt decorations is a trifle too rich for every-day consumption, but it is neither loud nor sickish.

This train was described in the *Railroad Gazette* of May 27, page 398; or, rather, it was there described as well as it could be described by half-tone engravings from photographs and by the use of the conventional architects' vocabulary. For any real appreciation of the beauties of these cars it is necessary, of course, to see them; for the color effects constitute the main test. As before intimated the general impression of tasteful design which strikes the observer on entering the first car is well sustained throughout the train. Leaded glass is perhaps used a trifle too freely, and the use of art glass in lamps is more justifiable as a decoration than it is for utility; the high windows in the dining car may or may not prove a desirable improvement, and the coloring of panels in the ceilings with a strong orange tint is perhaps justifiable only by the necessity of having variety; but, on the whole, these small criticisms are obliterated by the excellent general impression. The fixing of the lamps, in a number of these cars, on the sides somewhere near the level of the eye, instead of near the roof, seems to be due primarily to the desire for change, and secondarily, to a commendable purpose to more fully serve the convenience of passengers who wish to read; but the success of the arrangement depends, of course, not on a general decorative scheme, but on the correct placing of each individual light, which feature must be tested by time.

The coach and the chair car in this train have transverse partitions at the ends, such as are seen in many parlor cars (with the opening at one side), cutting off the body of the car from the view of a person entering at the door and also cutting off drafts of wind; but to avoid delay and inconvenience when the car is used for way travel the partitions are hung on hinges so that they can be opened like a door, leaving a direct passage to and from the platform. One of the cars in this train is a private car, with the usual bedrooms, kitchen, rooms for servants, etc., and it has a shower bath. Enameled tiling is freely used in bath rooms and in toilet rooms throughout the train.

The third train is an "Empire State Express" of four cars, exhibited by the New York Central. The parlor car is from the Pullman shops, but the others are from Barney & Smith. As the Empire State Expresses in actual service are at all times examples of the best cars in use, little that is new is to be expected here. In the day cars every seat is numbered, after the fashion of parlor cars. The finish is oak, with neat inlaid stripes. The headlining is light olive and the sides are covered with figured green plush. The window sashes have spring lifts. All of the cars in this train have both electric lights and Pintsch gas, seven incandescent electric lamps being fixed along each edge of the clear story. One of the day cars has a kitchen, and tables can be fixed between any two seats; and the floors are covered with linoleum.

The only standard car exhibited, aside from the foregoing, is a side-door suburban passenger car exhibited by the Illinois Central. This car is already well known to the readers of the *Railroad Gazette*, having been described in the issue of Sept. 4, 1903.

Notices of the city and interurban electric cars, and of some other things shown at the Exposition, must be deferred until a future issue.

*Continuation of articles on the St. Louis Fair printed Sept. 23 and Oct. 28.

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A steam-electric case has arisen before the Massachusetts Railroad Commission which has its meanings outside of the bounds of that State. The immediate matter involved was a petition of the Worcester & Webster Street Railway Company to connect by a short link with the Worcester & Southbridge —the former being, through an intermediary railway corporation, under lease to the New York, New Haven & Hartford. The opposition at the hearing alleged that the plan in-

volved the abandonment of electric tracks. This, alone, raises an interesting point as against the insistent Massachusetts policy of allowing consolidation—by lease or otherwise—only if service at least as good as before the lease is maintained. But more important than this was the undisputed assertion that since the lease not only had steam service at Auburn been diminished but also the electric service cut down from half-hour to hourly cars and the electric plant allowed to deteriorate. This, if we are not mistaken, is one of the many instances where the New Haven company has bought control of trolley lines to "block" parallels. If that process is to be attended with abandoned tracks and vitiated service the policy may "go" in Connecticut and Rhode Island, with their flabby and nerveless railroad commissions, but in Massachusetts it will find a horse of another color.

### The Block System in Iowa.

The space interval is the only rational, scientific and satisfactory method of running trains and protecting them from collision. The time-interval and flag-lantern-torpedo combination is cumbersome and troublesome at best, and is unworkable where trains are fast and frequent. But the fact that these truths are generally recognized does not insure millennial conditions, for it is easy to use the block system in a partial manner or to adopt its theory without enforcing correct practice, and without using well known electrical safeguards; and so we have situations like that in Iowa, illustrated in the discussion at the September meeting of the Iowa Railway Club. We print a brief abstract of it in another column.

Anyone familiar with practice under the block system on a road where it is regularly and consistently carried out, would say that the most of this Iowa discussion was useless, and possibly even vicious, many erroneous views being expressed and considerable time being used up in refuting fallacious arguments; but as those who took part in the discussion evidently were men engaged in the practical operation of trains, it cannot be said that anything which shall clear up points that are obscure to them is wasted; and a thorough airing of the subject ought to be of much permanent benefit. There can be no doubt that many trainmen accept the block system as a necessary evil and feel considerable opposition to it for months or years after they have begun to work under it, especially if the regulations for permissive blocking, or any of the rules, are administered in anything but the most accurate and businesslike manner. This being so there is ample room, if we are to continue the American theory of making employees more like men and as little as possible like machines, for instructive discussion.

The speakers brought out both bad and good points concerning practice in Iowa. Among the former were the following:

1. Permissive blocking is common. Permissive blocking is not necessarily vicious, but the utterances of some of the speakers indicated that as they had observed it, it was so, enginemen not running strictly under control. Unfortunately Iowa is not the only State in which this bad practice may be found.

2. With block stations at A, B, C, Station B is closed at night and trains which have to meet there are provided with telegraphic orders at A and C. While this is a suspension of the block system, it is to be observed that giving meeting orders for such movements is a great improvement over the practice of depending on time-table rules alone.

3. Operators, even the best of them, make mistakes, letting two opposing trains get together.

4. Trains doing work at stations are not suitably protected by fixed signals, and so the conductor must either send out flagmen or depend upon the station operator to notify approaching trains at the next station back; sometimes he thus depends when he has not assured himself that the operator understands the situation and so gets into trouble.

5. Operators are young and inexperienced and consequently commit errors which would be avoided by older men, such as conductors and enginemen.

All of these weaknesses exist because of the real or supposed need of keeping expenses within a predetermined limit. None of them are inherent in the system. As against the argument that the block system with these imperfections is worse than no block system at all, we have the testimony of many superintendents who have had 10 or 15 years' experience in just this kind of practice, that it is well worth its cost, taking it as it is. But in so far as these weaknesses are due to disobedience of rules, every railroad man in Iowa or in any other State, knows that the first duty is to correct the discipline, whatever the system. The block system is valuable in what may be called its reflex influence, for it makes so clear the value of good discipline, and makes it so much easier to begin, that many superintendents are shamed into putting their discipline on a better basis who would not have done so—at least not without further delay—if they had not been compelled, by the introduction of a new system, to study the rationale of discipline.

But the practice of Iowa furnishes encouragement also. One member declared that the block system was the true method even with only one train a day each way. There is genuine appreciation of the principle. The principle is sound, however clouded our practice and opinions may be. And this speaker was not indulging in hyperbole. Imagine a road 40 miles long, A to B, and no intermediate telegraph offices. The danger to our one train is from the single opposing train and from extras. Assume that No. 1 leaves A at 10 a.m. and arrives at B at 12 noon; and that No. 2 starts from B for A at 2 p.m. Is it not better for No. 2 to wait till No. 1 arrives at B, regardless of the clock, than to wait until a given time? Or, if an extra is to follow from A, is it not better for it to wait until No. 1 reaches B, provided the delay can be borne, thus relieving No. 1 of a lot of unnecessary flagging, than to have this flagging done day after day, and year after year, when, most of the time, no extra is following? This illustration is an extreme case; if there are intermediate telegraph stations, and freight trains every day, and if meeting points have to be made frequently, the argument is by these circumstances only made stronger.

That the advantages of the block system are intelligently understood in Iowa is shown by the remark of one of the speakers that when patches of fog are likely to obscure the view, enginemen prefer to wait for a clear signal rather than run on a caution card. This gives evidence that the caution rule is enforced and that the advantage of a clear signal for a whole block is appreciated. Another bit of significant testimony was that concerning cases where a despatcher sends out extras and forgets to give them all the meeting orders that they need. This is a kind of blunder which has usually escaped publicity; but since the Government began issuing its bulletins, cases appear every now and then. One member, speaking, no doubt, from experience, declared that this protective feature alone was sufficient to justify the use of the block system.

Last, but not least, the running of 65 work trains on two fifty-mile sections, for three summers, without a collision, is a fact worth recording in favor of the block system, albeit much permissive blocking was, no doubt, done.

Of the discussions of block signaling which appear in print, a large part is somewhat academic in its nature, for the reason that the cost of collisions is not often allowed to be made public in a way specific enough to be intelligently compared with the cost of the block system; and also because the cost of the collisions which would have occurred on block signaled roads, if the signals had not been adopted, must remain an unknown quantity; but bits of experience like those here recounted serve partly to supply this deficiency, hence we print them. The final argument against the block system was that it made men more careless. No particulars were mentioned, but the reference was, we suppose, to the determined way in which men will omit to flag back when they know that they are protected by a block signal. Mr. Campbell gave a simple answer to this, namely, that by proper discipline—which we judge, from the tone of his remarks, was not found difficult when the superintendent set about it with determination—the men were made to obey the rules. Another answer would be to make the block signaling so perfect that flagging can be dispensed with. That is the way they do it in England. The plea that improvements make men careless may easily be made too much of. The establishment of double track instead of single tends to make conductors and enginemen less alert and thoughtful than they were when they had to spend half their time in making astronomical calculations (or something akin to that kind of work); but no one is going to postpone building a second track on that account.

### Chicago, Milwaukee & St. Paul.

This company had a net income in the fiscal year ending June 30, 1904, of $10,718,400, about 2½ per cent. greater than the corresponding figure for 1903. The company has added 224 miles of line to its system. This consists of short branches and cut-offs pretty well scattered. It has completed its line into the coal fields in Illinois. It has added 47 miles of second track, completing this year the double tracking on the La Crosse Division from Brookfield Junction to Watertown Junction. It is building third and fourth tracks from Chicago to Milwaukee. Grade reduction in many places and track elevation in cities have been the feature of the year. For the former $1,129,000 was spent and for the latter $2,544,000.

The changes in the equipment roster have been small; 2,000 new freight cars were bought, 23 passenger train cars and 47 locomotives. This is a very small purchase of new equipment for so large a road. As it now stands about 5 per cent. of the freight car equipment and 5 per cent. of the locomotives are less than one year old. The company has been hard hit by the high price of coal. In order to avoid a repetition of the severe experience in this particular of the past few years, the company has entered vigorously into the policy of buying coal mines. In pursuit of this policy it has acquired title to coal lands, or coal patents, in Illinois aggregating 30,109 acres.

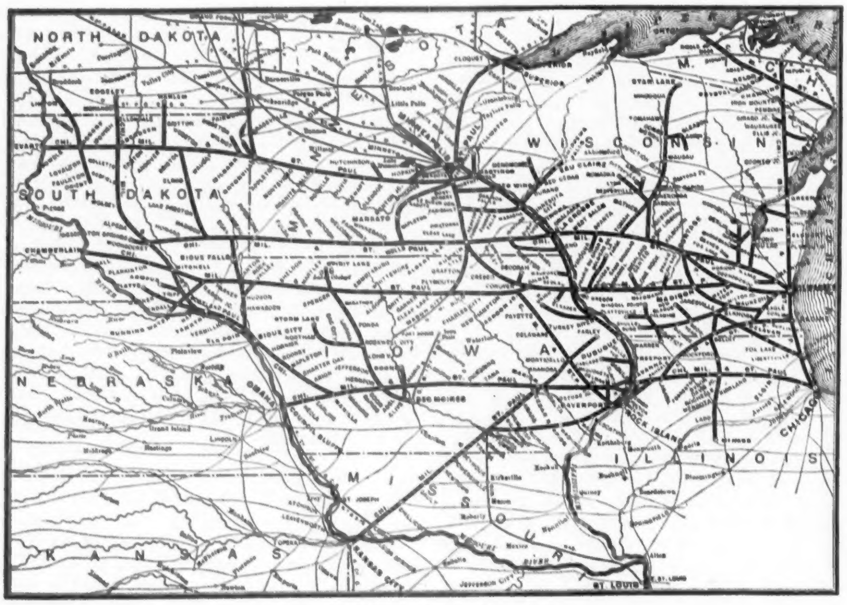
The expenditures for new work for the year amounted to $9,307,000. Of this amount $5,520,000 was charged to capital account. The remainder, namely, $3,787,278, was

charged to renewal and replacement fund, which in turn, of course, is supplied out of earnings.

The money for this expenditure was taken from current funds and resources. No new capital was raised during the year. The change in the balance sheet is indicated below:

| | |
|---|---|
| *Debit.* | |
| Increase of liabilities— | |
| Common stock | $650,000 |
| Profit and loss | 3,299,919 |
| Decrease of assets— | |
| Trust funds | 62,035 |
| Special funds | 32,817 |
| Materials | 445,171 |
| Current assets | 2,520,028 |
| | $7,009,970 |
| *Credit:* | |
| Increase of assets— | |
| Cost of road | $4,464,316 |
| Bonds, stocks, etc. | 1,056,254 |
| Treasury securities | 213,000 |
| Decrease of liabilities— | |
| Funded debt | 650,000 |
| Current liabilities | 626,400 |
| | $7,009,970 |

Funded debt decreased $650,000, while capital stock increased a like amount. This was due to the conversion of convertible bonds into stock.


Chicago, Milwaukee & St. Paul.

The income account is given below:

| | 1904. | 1903. | Increase. |
|---|---|---|---|
| Gross receipts | $48,330,334 | $47,662,737 | $667,597 |
| Exp. and taxes | 31,876,589 | 31,598,174 | 278,415 |
| Net earnings | $16,453,744 | $16,064,563 | $389,181 |
| Other income | 316,430 | 510,030 | *193,600 |
| All income | $16,770,175 | $16,574,593 | $195,582 |
| Charges | 6,051,775 | 6,101,335 | *49,560 |
| Balance | $10,718,400 | $10,473,258 | $245,142 |

*Decrease.

If we add to the stated net income the $3,787,278 of expenditures for improvement work charged to renewal and replacement fund and deduct $389,878, the net amount this fund was drawn down during the year, we find that the actual earnings on the common stock were 18.4 per cent.

The increase in gross earnings was insignificant, something over 1 per cent. It was about 5 per cent. in 1903 and 8 per cent. in 1902. The increase was fairly well distributed among passenger, freight and mail and express. The increase in freight revenue, however, does not represent an increase in freight business. There was actually a decrease of ton miles hauled of about 2 per cent., while the average ton-mile revenue increased from 8.65 mills to 8.91 mills. Agricultural products and coal tonnage increased, but the increases here were more than offset by declines in ore and forest products, agricultural implements and other commodities not specified. The decrease in ore tonnage reached nearly 500,000 tons, and this may be taken as the real cause for the decline in the total tonnage.

Expenses apparently have been kept in hand, but closer examination shows that the maintenance expense has been seriously curtailed to offset the very large increase in the expense of conducting transportation. The detail is:

| | 1904. | 1903. | Inc. or Dec. |
|---|---|---|---|
| M. of way | $5,128,248 | $7,347,048 | $2,218,800 D. |
| M. of equip. | 4,651,783 | 3,893,834 | 757,949 I. |
| Cond. transp. | 18,597,342 | 16,829,795 | 1,767,547 I. |
| Gen'l expenses | 1,190,907 | 952,309 | 238,598 I. |
| Taxes | 1,600,732 | 1,470,187 | 130,545 I. |
| | $31,169,012 | $30,493,173 | $675,839 I. |

The company has borrowed heavily from maintenance to pay current bills of transportation, while the freight business has actually fallen off, as noted above, about 2 per cent. The maintenance outlay for equipment while higher than last year is far from liberal. It is: Per locomotive, $1,493; per passenger car, $531; per freight car, $38.

This curtailment of maintenance outlay is noticeable from another point of view, namely, the per cent. of new equipment charged to expenses. For freight cars it was but 1 per cent., for passenger train cars but ½ per cent., and for locomotives 2 per cent. On the other hand transportation expense has increased $1,767,000, or over 10 per cent. In three years transportation expense has increased $4,665,000, while gross earnings have increased $4,961,000, or only about $300,000 more than the actual direct expense of handling the business. If we take transportation and general expense together, we find that they have increased $5,049,000, or actually $87,000 more than gross earnings in the same time.

Two things are conspicuous in this: (1) Gross earnings do not increase at the rate we might expect them to in a growing country; (2) the expenses have increased excessively. Transportation expense in 1901 was 33 per cent. of gross earnings. In 1904 it was 38 per cent. The explanation lies in wages and the fuel bill. As "St. Paul" serves as a fair sample of what many roads are showing in their transportation expense we give below the items under this head:

| | 1904. | 1903. | Increase. |
|---|---|---|---|
| Superintendence | $352,289 | $532,902 | *$180,612 |
| Eng. & rndhsemen. | 3,326,550 | 3,050,645 | 275,904 |
| Fuel loco. | 4,620,745 | 4,079,948 | 540,796 |
| Water supply, loco. | 179,209 | 143,996 | 35,213 |
| Oil, tallow & waste | 122,751 | 96,313 | 26,437 |
| Other loco. supplies | 56,904 | 61,555 | *4,650 |
| Train service | 2,406,975 | 2,069,528 | 337,447 |
| Train s'plies & exp | 511,548 | 434,659 | 76,889 |
| Switch, flag and watchmen | 1,382,048 | 1,227,225 | 154,823 |
| Telegraph | 354,520 | 332,132 | 22,387 |
| Station service | 2,511,282 | 2,363,251 | 148,031 |
| Station supplies | 201,658 | 185,785 | 15,872 |
| Switching charges | 244,232 | 131,346 | 112,886 |
| Equipment hire | 188,387 | 141,495 | 46,891 |
| Loss and damage | 335,949 | 263,922 | 72,026 |
| Injuries to persons | 318,861 | 302,600 | 16,260 |
| Clearing wrecks | 52,684 | 42,972 | 9,711 |
| Advertising | 154,036 | 150,645 | 3,390 |
| Outside agencies | 498,404 | 469,180 | 29,223 |
| Stkyds. & elevators | 56,777 | 49,379 | 7,398 |
| Rents, tracks | 331,290 | 317,858 | 13,432 |
| Rents, buildings | 52,423 | 44,194 | 8,228 |
| Stationery & p't'g. | 186,976 | 186,909 | 67 |
| Other expenses | 150,833 | 151,345 | *512 |

*Decrease.

The decrease in the first item of $180,612 is probably due in large part to reclassification, for general expense shows an increase of $119,000.

To sum it up Chicago, Milwaukee & St. Paul has accumulated ample reserves to provide for just such a year as 1904. There is absent the marked tendency to expansion which the generally new character of the country would lead one to expect. No financing has occurred this year. The company has had to curtail, however, and these curtailments have been in maintenances. The problem before the officers is how to reduce the coal bill and how to hold wages in hand. Their purchase of coal lands is to save in the coal bill. They have been vigorously bettering facilities by double tracking long sections and by reducing grades.

### Atchison, Topeka & Santa Fe.

The Atchison has increased its operated mileage 297 miles, the Southern California, which last year was reported separately, being this year incorporated with the system, so that the total now reaches 8,301 miles. The income account was:

| | 1904. | 1903. | Inc. or Dec. |
|---|---|---|---|
| Gross earn'gs. | $68,171,200 | $62,350,397 | $5,810,803 I. |
| Other income. | 1,248,775 | 1,317,993 | 69,218 D. |
| All income. | $69,419,975 | $63,668,390 | $5,751,585 I. |
| Expenses, taxes and rentals. | 44,641,434 | 40,635,576 | 4,005,858 I. |
| | $24,778,541 | $23,032,814 | $1,745,727 I. |
| Charges | 9,418,770 | 9,134,485 | 284,285 I. |
| Surplus | $15,359,771 | $13,898,329 | $1,461,442 I. |

The increase in gross is 9 per cent. and in net 10 per cent. The road earned 5 per cent. on the preferred and 9.4 per cent. on the common stock. The sum of $14,553,780 was spent during the year for the construction and acquisition of additional railroads, for equipment and for other properties and for improvements. The way the expenditure was financed is shown by the table below; $7,500,000 was raised on bonds and $4,600,000 was taken out of current cash.

| | |
|---|---|
| *Debit.* | |
| Increased liabilities— | |
| Funded debt | $7,502,800 |
| Accounts payable | 54,337 |
| Profit and loss | 2,333,344 |
| Decreased assets— | |
| Accounts receivable | 819,218 |
| Cash | 4,597,881 |
| | $15,307,580 |
| *Credit:* | |
| Increased assets— | |
| Road and investments | $10,993,870 |
| Securities on hand | 171,480 |
| Other investments | 989,211 |
| Materials and supplies | 1,611,077 |
| Trust funds, etc. | 183,986 |
| Decreased liabilities— | |
| Special funds | 1,344,112 |
| Accrued interest and taxes | 13,844 |
| | $15,307,580 |

The increase in gross earnings was fairly distributed among passenger, freight, mail and express. But the increase in freight earnings was due to the increase in the aver-

age rate from 9.48 to 10.20 mills per ton per mile. The actual freight handled was very slightly less than last year. The detail of earnings and expenses appears below:

| Earnings: | 1904. | 1903. | Increase. |
|---|---|---|---|
| Passenger .. | $15,433,773 | $13,469,985 | $1,963,787 |
| Freight ..... | 47,762,653 | 44,622,438 | 3,140,214 |
| Mail and exp. | 3,835,662 | 3,411,697 | 423,964 |
| Miscellaneous. | 1,139,111 | 846,275 | 292,836 |
| Total .... | $68,171,200 | $62,350,397 | $5,820,802 |
| Operating expenses: | | | |
| Maint. of way | $9,170,234 | $9,304,892 | *$134,658 |
| Maint. of equip | 10,006,135 | 8,510,543 | 1,495,592 |
| Cond transp. | 21,295,960 | 19,023,145 | 2,272,815 |
| Gen'l exp... | 1,749,702 | 1,598,530 | 151,172 |
| Total ..... | $42,222,032 | $38,437,110 | $3,784,922 |
| Net .......... | 25,949,167 | 23,913,286 | 2,035,880 |

*Decrease.

The gross earnings per mile are larger than ever before. The growth in the last seven years is indicated below.

| | Gross earnings, per mile. | | Gross earnings, per mile. |
|---|---|---|---|
| 1897..... | $4,752 | 1901..... | $6,977 |
| 1898..... | 5,653 | 1902..... | 7,527 |
| 1899..... | 5,760 | 1903..... | 7,827 |
| 1900..... | 6,297 | 1904..... | 8,334 |

The striking thing about gross earnings is the rapid increase of passenger earnings:

| | Freight. | Passenger. |
|---|---|---|
| 1897.............. | $22,067,686 | $5,574,288 |
| 1898.............. | 28,588,716 | 7,347,361 |
| 1899.............. | 29,492,586 | 8,126,141 |
| 1900.............. | 33,729,332 | 9,334,661 |
| 1901.............. | 39,052,557 | 11,678,017 |
| 1902.............. | 41,815,607 | 13,439,384 |
| 1903.............. | 44,622,438 | 13,469,985 |
| 1904.............. | 47,762,653 | 15,433,773 |

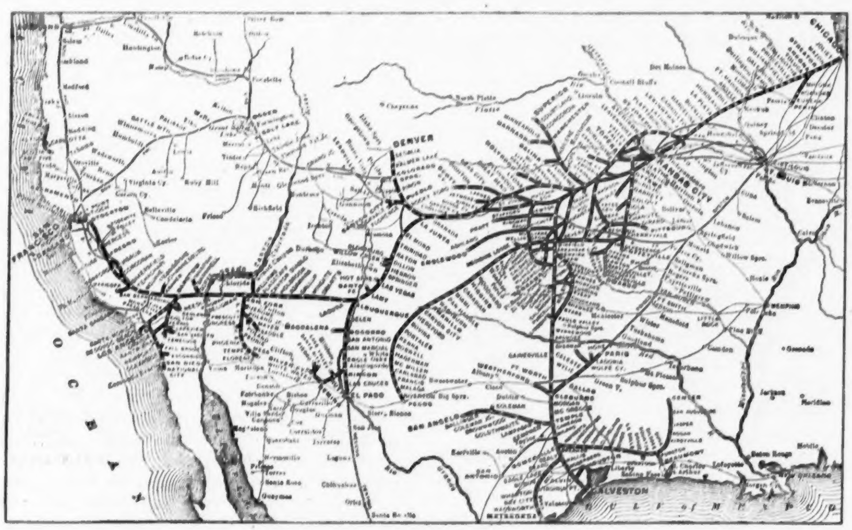
The operations of 1904 were seriously harassed by floods in Kansas. In parts of the State the rivers were out of their banks on three separate occasions. Many bridges were lost and considerable track destroyed. But the Maintenance of Way expense was practically the same as the year before. Maintenance of equipment was about $1,500,000, or nearly 20 per cent., greater than in 1903. Conducting transportation expense increased 12 per cent. In common with all other roads Atchison was unable to hold this expense in hand. Its fuel bill jumped a round million of dollars, or about 25 per cent. But the wages situation appears to have been in fair control. The increase in train service expense was but about $200,000, and for engineers and firemen but about $50,000. In another respect the Atchison shows pretty well—namely, in the expense of wrecks and loss and damage, which, while larger than last year, yet has not so outrun the volume of business as is the case on many roads. During the year the company acquired new equipment as follows:

| | Charged to— Capital. | Operating exp. |
|---|---|---|
| Locomotives .......... | 124 | 27 |
| Freight cars .......... | 1,860 | 1,283 |
| Passenger cars ......... | ... | 68 |

About 11 per cent. therefore of the locomotives, 8 per cent. of the freight, and 8 per cent. of the passenger equipment is less than one year old.

The revenue freight train load fell off from 279 to 269 tons, but the higher ton mile revenue saved the freight train mile revenue and pushed the average up from $2.65 to $2.75.

Atchison's year has not been one of especial achievement, but the road has fairly held its own.



Atchison, Topeka & Santa Fe.

## NEW PUBLICATIONS.

*Tractive Power Chart.* Published by The Derry-Collard Company, New York: 1904. Price 50 cents.

This chart has been prepared to show graphically the theoretical drawbar pull of any locomotive. Three sets of curves, projected from each other are used; full directions are printed on the chart. Cylinder diameters are given for each half-inch from 15 in. to 45 in., and piston strokes for each two inches from 20 in. to 36 in., and these are plotted to give curves of cylinder volumes. In the same way the relation between boiler pressure and wheel diameter is shown in a series of curves and these two sets of curves are projected from the top and side to give a third set showing tractive effort. Boiler pressures are taken from 120 lbs. to 230 lbs. reduced by 15 per cent. to give assumed mean effective pressure and wheel diameters are taken from 20 in. to 90 in.

*The New York Subway*: Its Construction and Equipment. New York: The Interborough Rapid Transit Company, 1904.

This souvenir of one of the greatest pieces of municipal engineering in the world has been compiled by the Interborough Rapid Transit Company to commemorate the opening of the subway on October 27. It contains an introductory history of the conception of the project, a general description of the line and the stations, a description of the types and methods of construction of the tunnel, a description of the power house equipment, system of electrical supply, signals, rolling stock, shops, and miscellaneous features. A list is given in the back of the book of all of the contractors who did work on the subway. Many handsome photographs illustrate the descriptions throughout the book and no pains nor expense has been spared to make this souvenir artistic and attractive. The McGraw Publishing Company had charge of the publication of the book.

*Proceedings of the Thirty-eighth Annual Convention of the Master Car Builders' Association.* 1904. J. W. Taylor, Chicago (The Rookery), Secretary.

Although this year's volume of the Proceedings is not quite so large as that of last year it contains quite as much information of value and of interest in the papers and discussions read before the last convention at Saratoga. The changes in standards as voted up by letter ballot have been made on the plates in the back of the book. The chief value of the book is that it is the only accurate and authentic compilation of the standards and recommended practice of the association, and is therefore an almost indispensable reference book for those who have to do with any branch of car building.

*Proceedings of the Thirty-seventh Annual Convention of the American Railway Master Mechanics' Association.* 1904. J. W. Taylor, Chicago (The Rookery), Secretary.

A comparison of the size of the volumes of these Proceedings from year to year is a fairly good indication of the importance and amount of the work which this association has accomplished since its organization. This year's volume contains 552 pages of text and is the largest yet published. Our readers are so familiar with the contents of these volumes from year to year that any review of them would be superfluous. In every way this year's volume is uniform with those of previous years.

## TRADE CATALOGUES.

*The Union Pacific* has been distributing a passenger advertisement in the shape of a small magazine containing the platforms of the four principal political parties—Republican, Democratic, Prohibition and Peoples, and the letters of acceptance of the Presidential candidates. Accompanying the magazine is the road's Agricultural Bulletin No. 32, which concerns the potato crop of Nebraska for 1904. It gives by counties the acreage planted to potatoes, the yield per acre and the total yield. The latter amounts to 8,774,245 bushels from 74,552 acres.

*The Sullivan Machinery Company*, Chicago, sends its October bulletin number 48-B, in which is given a detailed description and illustrations of the Sullivan chain mining machine. This machine is used for undercutting coal in both room and pillar mines. Some figures as to the time and cost of the mechanical undermining of coal are also given.

*The Wile Power Gas Company*, Rochester, N. Y., maker of gas producers for power and fuel, sends its catalogue A. This describes producer gas, its uses and costs, and compares it to other forms of power, such as steam engines, etc. It also shows the efficiency of producer gas as a fuel compared with coal fires, illuminating gas and natural gas.

*The McMyler Manufacturing Company*, Cleveland, Ohio, has issued a new catalogue. The company designs and builds hoisting and conveying machinery, and the catalogue illustrates and describes revolving cranes, coal conveyors, ore conveyors, coal storage plants, car dumping machines, clam-shell buckets, including special designs for ore; orange-peel buckets, hoisting engines, electric conveyors, and all kinds of buck-

ets. The attention of railroad men is directed to an arrangement for coaling locomotives and taking out ashes at small towns, that is claimed to be economical and convenient.

*Chds. E. Hatt Company*, Grand Rapids, Mich., issues a catalogue of Hatt's furniture and miscellaneous varnishes, and of polishes, colors, stains and varnish and paint remover.

## CONTRIBUTIONS

### Train Registers and Other Things.

Buffalo, N. Y., Oct. 31, 1904.

TO THE EDITOR OF THE RAILROAD GAZETTE:

The contribution of Mr. H. W. Forman in your issue of Oct. 28 on defective train rules, and particularly his elucidation of practice under Rule 96, makes an illuminating chapter; every trainman, operator and despatcher ought to read it. But will not the reader rise from the perusal of this letter with the feeling that it is only a beginning? Any number of suggestions arise in one's mind as he reflects on the exigencies of train work here touched upon. Any one who reads Mr. Forman's book will find still other suggestions.

For example, what a nest of unpleasant features one finds in connection with train registers. Speaking to almost any superintendent or trainmaster you may pertinently ask:

Are the page forms of your registers simple and clear? Are trains going in one direction entered on one page and those in the opposite direction on the other? Is a page set apart for each day's business? Are trains entered correctly and is the arriving or leaving time always plainly shown? Do men who receive orders to meet trains at such points always carefully consider the time that a train is registered in connection with the time their order is completed, to make sure that the train is not making a second trip and has not arrived on the trip which their orders indicate it shall be met or waited for? Do men use all the time necessary to check up registers, or do they hurry through the duty perfunctorily? Are trains always registered on the proper page?

Are all orders delivered to enginemen personally by the conductor or operator, or does the conductor sometimes send an order by his brakemen? Who on a train read train orders? When it is discovered that men are careless about their duties in safely handling their train, what corrective measures are applied? Are men disciplined for failure to properly care for their train even though an accident does not result from such neglect?

How much territory are despatchers handling? Assuming that 40 orders is a safe day's work, are they required to give 60 or 75? How many hours do they work each day? What is the age and experience of operators? Who examines them? What do they know about the rights of trains? How are they keeping the records at stations? What kind of signals are they required to keep at hand, and are these kept in their proper place at the station? What are the personal habits of employees when off duty? Are there any men employed who are over 70 years old? Any 15-year-old boys? Any men who are notoriously sleepy, or reckless and indifferent as to their work?

Are there any train-order signals so located that they cannot be seen until a train is nearly upon them? When men find switch or other fixed signals not burning at night, what do they do? Is there a record of all such imperfect signals at headquarters? In cases where a train is directed to display signals for a following section, when are they put up; before the train starts from such station, or after running a few miles? If indicators are used, are they taken in upon arrival at terminals, or allowed to remain in place in the caboose until the men come around to go out on another trip? Do enginemen give whistle signals invariably, and are they always answered by two short blasts? If not answered, what does the engineman do to prevent the other train from moving against the following sections? Do they invariably report their brother enginemen who fail to answer such signals, or do they cover the circumstance up? When double-headers are run is the second engineman required to watch such things also? Are train orders checked up to see if they are in proper form and that no orders are given that might mislead train and enginemen? And so on *ad finem*.

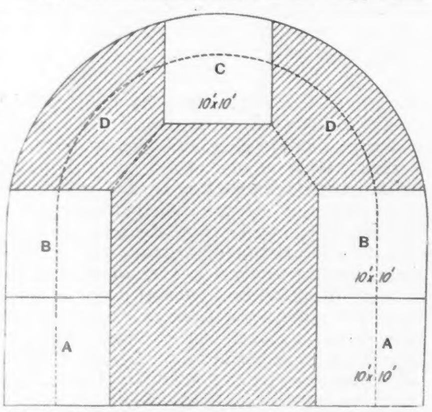
The mistakes prevented by trifling accidents, and by reminders in the most unusual way, would be appalling if they were to become known. It may be a brakeman, or the conversation of a passenger on a train that reminds a conductor or engineman. Hence the necessity for surrounding train movements with every possible safeguard, even to carrying the matter so far that it may at times prove burdensome. A large book could be written on the one word "habit."

An operator once told this incident: Before repeating an order he was of course required to state that his order signal was displayed at "stop." On the night in question he so stated, but forgot to so display the signal. A passenger applied for a ticket to go on this train, remarking that he was aware that the train was not scheduled to stop at that point, but as it was an urgent case he thought the operator might get permission to stop it. The operator informed him that this was unnecessary, as he held an order for the train, and that it would have to stop to get it. The passenger inquired as to how the train would know that there were orders and was told that the order signal showing red would indicate this. The collision was prevented by this passenger calling attention to the fact that the signal was showing a white light.

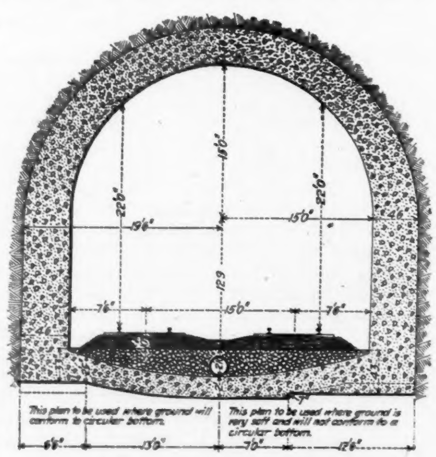
J. B. C.

### Great Northern Tunnel at Seattle.

Last week we published a description of the terminal improvements which the Great Northern and the Northern Pacific are jointly carrying out in Seattle, Wash. Only brief mention was made of the tunnel being driven under the business section of the city, which




Method of Driving Drifts in Seattle Tunnel.



Section of Seattle Tunnel.

is nearly a mile long and which is perhaps the most difficult part of the work, involving the expenditure of the most skill and money. We are now enabled to give a more complete description of this part of the work and to show the accompanying illustrations from photographs taken during the progress of the construction.

The tunnel is being built to relieve the congestion along the water front. All of the terminal tracks and yards of both roads run along the edge of the bay, and the interference of traffic in the yards and on the main line is now so great that some steps for the relief of the congestion were imperative. Although up to the present time the progress of this work has attracted but little attention, this tunnel is one of the most important engineering projects which has ever been attempted on the Pacific Coast. Preliminary surveys were made in the early part of 1903 and the work was begun at the north end of the tunnel in May of that year. In July work was begun at the south end. The exact length of the tunnel is 5,130 ft. It is 30 ft. wide between the side walls and 28 ft. high from the top of rail to the crown of the arch. The accompanying illustration, which is reproduced from the article in last week's issue, shows the dimensions of the cross section and the concrete lining of the tunnel.

The peculiar nature of the soil underlying Seattle made the work dangerous and difficult at times. A stratum of blue clay containing large amounts of water underlies the surface soil to a depth of 150 ft. or more, and as the tunnel was driven through this clay the water draining down through the soil caused some dangerous settlements at the surface above. There was little danger of caving or collapse in the heading and no necessity for using a shield or compressed air, but there was no method by which this seepage could be prevented. Facing on the streets above the tunnel are a number of the largest buildings in the city, many of which are of recent construction, and although every precaution was taken to prevent serious settlements under these buildings, some settlements did occur. The Stander Hotel, which was in process of building, settled so that cracks two inches wide appeared in the walls when the tunnel bore was advanced under it. This building was shored up by the railroad companies and the necessary repairs made so that the building could be completed. The tunnel at this point is 132 ft. below the surface of the ground. Another building, the Hotel York, which stands only a little distance from the entrance to the tunnel and where the depth is not great, settled so that the building was condemned. This building and the ground on which it stood were bought by the railroad companies and the building is now being torn down. Aside from these two cases the damage has been comparatively slight and the engineers in charge anticipate no further trouble. The soil has settled as much as it is likely to do, since the water

Timber Forms for Concrete Arch Ring.

which drained into the tunnel and caused the porous earth to compact is now practically exhausted.

The method of driving the tunnel was rather an unusual one. The accompanying diagram shows the five drifts which were carried forward as the work progressed. Each of these drifts are 10 ft. by 10 ft., and the work was carried on in the same manner simultaneously at both the north and south ends of the tunnel. Drifts A along the sides of the invert were started first, and up to within the last few hundred feet were always kept from 10 ft. to 20 ft. in advance of drifts B. Drift C was advanced at the same rate as drifts B. As the work on the drifts progressed, 12 in. x 12 in. timbers were used to shore up the roof, and the permanent timber lining for the sides of the tunnel was put in place. After the side and top drifts had been advanced about 100 ft. the triangular cores between drifts B and C were removed and the roof shored up to the crown of the arch as this work progressed. The concrete lining in the side walls was put in close up to the headings of the side drifts. Following 100 ft. in the rear of the gangs employed on this work were other gangs employed in stoping out the main core. The excavation in the drifts has been done almost entirely with pick and shovel, the soil being carried out in wheelbarrows and on traveling belts. At one or two points some small quantities of rock were encountered, but no blasting was done in the tunnel. After the tunnel had been advanced some little distance from the portals, temporary tracks were laid and the dirt hauled to the portal of the tunnel in contractors cars with small steam locomotives.

About 1,000 men have been employed on the work since August, 1903. These were divided into three eight-hour shifts and men were at work in the headings continuously. Most of the men employed were experienced miners who were familiar with underground work and very expert in shoring and timbering and in doing clean and rapid work of this kind. Throughout the construction of the tunnel there has been keen rivalry between the gangs working on the north and south ends, and it was this rivalry which caused the foreman on the south end to have installed a traveling belt so that his gangs could work the faster. This conveyor was found to work satisfactorily and to greatly facilitate the removal of the excavated material from the drifts.

In order to obtain sufficient depth under the business section of the city it was found

Removing Main Core after Timber Arch and Concrete Side Walls Were Completed.

necessary in making the surveys to put in two 4-deg. curves. It was a delicate surveying feat to keep both ends of the tunnel advancing along the assumed lines with absolute accuracy, but when the gangs met in the center, the calculated length of the tunnel and the actual length were found to differ but 1 in., and only ¼ in. deviation in the running lines and ⅛ in. in the levels of the two ends occurred. This is really a remarkable feat in view of the circumstances.

At one point in the tunnel about 130 ft. below the surface the remains of a prehistoric forest were encountered in the headings. One tree 3 ft. in diameter was unearthed in a perfect state of preservation. It was embedded in the clay and was saturated with water. On being brought into the dry, open air it rapidly crumbled and disintegrated into a little heap of mould. The hilly formation of Seattle is supposed to be due to the action of a big glacier from Mount Rainier, which moved into the sea about 2,000 years ago, and the remains of this forest found under the ground are probably that old.

The exact progress of the tunnel on November 1 was as follows: Drifts C at the north and south ends had met. The ceiling

View of Completed Tunnel about 1,000 Feet from South Portal.

had been shored up and the concrete in the crown was expected to be completed within a week. Drifts A and B were still separated by a distance of 180 ft. between the two ends and 450 ft. of the main core remained to be excavated. The meeting point of drifts C is 2,730 ft. from the south end and 2,400 ft. from the north end. It is expected that within two months the tunnel will be entirely completed and tracks laid, but it will not be put into use for about a year, since the other terminal improvements, including the new passenger and freight depots, have not yet been completed. It is estimated that the cost of the tunnel alone will be more than 1½ million dollars.

Mr. A. H. Hogeland, Chief Engineer, Great Northern, and Mr. Alexander Stewart, the Resident Engineer on the work, had entire charge of this work and the other terminal improvements, and we are indebted to them for information furnished.

## The Railroad Cross-Tie Problem.

BY S. WHINERY, CIVIL ENGINEER.

(*Concluded from page* 528.)

3. Reinforced concrete is just now receiving a good deal of attention as a possible substitute for railroad cross-ties. Admirable as concrete is for a large number of structural purposes, the inherent qualities of this material are such as to prejudice the conservative railroad man against its use for cross-ties, even when steel-reinforced in the best manner, subjected as it is must be to the incessant and very severe shocks of passing railroad rolling stock. If it could be used as a track support in such a way that it would be subjected to compression only, and then through the distributing intervention of steel or wooden beams, the prospect would be more prepossessing.

In Fig. 4 I have attempted to design a reinforced concrete cross-tie in accordance with our best lights on the subject at this time. Its dimensions and construction will be evident from the sketch. This is clearly a case where we cannot neglect the consideration that a cross-tie acts as a continuous girder. At the middle of the tie the reinforcing steel must be at the top, while under the rails it must be at the bottom of the tie. Some designs have attempted to meet this condition by bending the steel rods and so building them into the concrete tie that they shall be properly disposed to take care of the strains. I have adopted the simpler arrangement of using two sets of rods, one in the top and the other in the bottom, overlapping each other at the point of flexure in the tie. The moment of resistance of this reinforced beam, both at its middle and under the rails, figured by well known formulæ, allowing a fiber stress of 12,500 lbs. per square inch of steel, seems to be about the same as that given above for the standard wooden tie. Unless, therefore, it should succumb to the repeated impact shocks of modern railroad service, it may be considered equivalent in strength to the wooden tie. As shown, its construction requires 3.54 cu. ft. = 0.131 cubic yard of concrete and 51 pounds of steel (including tie plates, anchor plates and anchor bolts). Its weight would be not less than 500 pounds. Its cost can only be roughly estimated, since it involves some elements upon which we have little data. Among these may be noted the cost of molding concrete into such small forms, the danger of injury and breakage in removing the ties from the forms and storing them (unless they were allowed to remain in the forms longer than economy of manufacture would probably permit); and the important fact that the ties must be stored, watered and otherwise cared for for at least six months before they become sufficiently "set" to put on the market. Those most familiar with such work would hardly place the cost of the concrete below $7 per cubic yard, and if we call the cost of the steel 2¼ cents per pound (both including a reasonable profit to the manufacturer), the cost of the tie, ready to ship, would be about $2. But to this must be added the cost of loading, transportation to the point of delivery, and unloading the ties. Considering that four of them weigh over a ton, 30 cents per tie would probably be a low allowance for these items, and the delivered cost would therefore be about $2.30 each. In view of the printed reports that concrete ties are made for less than $1 each, this estimate seems high; but I believe that a careful study of the matter, and, later, experience, will convince the competent engineer or manufacturer that the market price would be above rather than below the figure I have estimated.

The problem of a suitable fastening between such a tie and the rail is a troublesome one. Anchor bolts built into the tie with anchor plates at the bottom and rail plates at the top, would seem to promise the best results, but experience is required to determine the stability and adhesion of such bolts in the concrete when subjected to the incessant shocks of passing trains, and they would weaken the section of the tie directly under the rail to a greater degree than the spikes in the wooden, or the bolts in the metal tie. Furthermore, these bolts, if broken or disabled, could not be replaced without taking out the tie, which is a very serious objection.

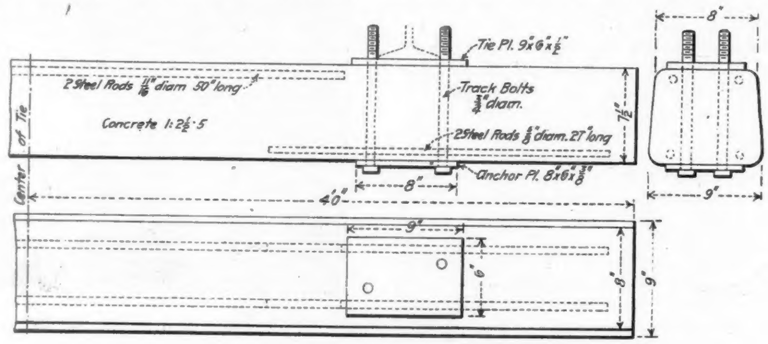



Fig. 4—Reinforced Concrete Tie.

| Quantities: | Pounds. |
|---|---|
| Concrete = 3.54 cu. ft. = 0.131 cu. yd. | 496 |
| Steel: | |
| 8⅓ ft. of steel rod | 10.3 |
| 4½ ft. of steel rod | 4.6 |
| 2 tie plates | 16.3 |
| 2 anchor plates | 13.6 |
| 4 bolts | 6.6 |
| Total, steel | 51,4 |
| Total, tie | 547.4 |

The inertia due to its great weight and the friction between its comparatively rough sides and the ballast should make the concrete tie superior to either the wood or metal tie in lateral stability of track.

The behavior of a concrete tie under the severe conditions of modern trunk-line track must, at this time, be considered purely conjectural, and any estimate of its useful life must be little better than a rude guess. He would, I think, be a bold advocate who would claim a longer life for it than seven or eight years.

4. Quite a number of designs for a cross-tie made by combining concrete with some form of steel-beam have been proposed. To anyone who will go into the matter carefully it will, I think, seem at least doubtful whether any such design can be devised that will give more strength per dollar invested in its construction than the concrete beam reinforced with steel rods. That it may, however, have special advantages, regardless of cost, may readily be conceded. Most of the ties of this class that have appeared, and some of which are undergoing trial in track, are so badly designed that they are foredoomed to failure. Old rails and scrap angle-irons are not good sections to use for the purpose, and even if they were, their supply for making ties on a commercial scale might be questionable. After some study of the matter I am inclined to believe that the most promising design for a tie of this general character will be found in the combination of a steel "I" beam of such section and area that it will, alone, have a moment of resistance equal or nearly equal to the standard wooden tie, with a concrete base that will supply the requisite bearing area on the ballast.

Fig. 5 illustrates what I have in mind. Here the 4½ inch I beam weighing 10½ pounds per foot has a moment of resistance of about 43,000 inch-pounds. It is embedded to about half its depth in a plain concrete beam having a bottom width of 9 inches. The rail fastenings are the same as those used with the all-steel tie. Such a tie should have good holding power in the ballast, and aside from the greatest defect of all concrete for ties—its brittleness—should promise satisfactory service. Even if the concrete should fail before the I beam, the tie could be removed from the track and rebuilt at a small part of its original cost. Making allowance for this possibility of renewing the tie, we might reasonably expect a much longer average life for it than the steel-reinforced concrete tie, or, say, at a rough guess, twelve or fifteen years. Its total weight would be about 450 lbs., and its cost, delivered, would probably be about $3.25 each.

It would be hardly correct to speak of the treated wooden tie as a substitute for the common tie, but in any fair comparison of the merits and economy of different kinds of ties, it must be taken into consideration.

The cost of untreated wooden ties varies greatly in different sections of the United States, ranging from about 30 cents to 60 cents. The average cost of the best quality of ties probably does not exceed 50 cents. The cost of preservative treatment also varies widely with the process and the thoroughness of the work. At present nothing better than creosoting is known. To thoroughly impregnate wood with creosote oil may require, say, twelve pounds of oil to the cubic foot of wood, and the cost of the treatment complete may vary from 75 cents to $1 each

for the standard tie. Calling it 90 cents, and assuming that the untreated tie costs, delivered, 50 cents, the cost of the treated tie will be about $1.40 each. The useful life of such treated ties has not yet been satisfactorily determined. There is good reason to believe they would last twenty years, but we shall be on the safe side in assuming that treated hard-wood ties will render good service for seventeen years.

*Relative Economy of Different Ties.*

The relative economy of different kinds of ties is the question that most keenly interests the railroad manager or engineer. As between ties equal in their safety and utility, the elements that enter into the problem of relative economy are:

1. The first cost of the tie, delivered.
2. The useful life of the tie.
3. The cost of tie renewal and of track maintenance, in so far as it may be affected by the kind of tie used.
4. The cost of interest on investment, and of a sinking fund.
5. The value of the worn out tie when removed from the track.

We have already roughly estimated the cost of the several kinds of ties we have considered and the probable useful life of each.

It is often assumed that the cost of track maintenance would be materially less if metal or concrete ties were substituted for those of wood. Experience in the United States is yet too meagre to supply reliable data on this point. The steel ties that have been tried here were entirely too weak for the service to which they were subjected, and, as might have been expected, track maintenance was much more expensive than with standard wooden ties. Foreign experience has been more favorable to the metal tie, and there are reports based on a considerable experience showing decided economy over wooden ties, in cost of maintenance. But the lighter rolling stock and the less frequency of trains in nearly every case must be taken into consideration. Excluding the cost of renewal, it might reasonably be expected that with ties of equal strength and bearing area, the cost of track maintenance would be practically the same, regardless of the material of which the tie be composed, and in the absence of evidence to the contrary we may assume this to be the fact. The cost of putting a new tie into the track, and of taking it out when worn out, may properly be considered apart from the cost of track maintenance and charged to the cost of the tie. The cost of putting in a new wooden tie seems to be about 10 cents, and the cost of taking it out $2\frac{1}{2}$ to 3 cents. If we charge against the new tie for "renewal" 12 cents, we shall not be far wrong. The

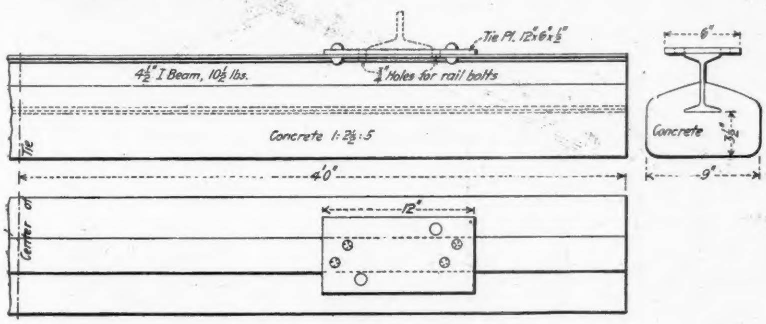



**Fig. 5—Concrete I-Beam Cross-Tie.**

Quantities:

| | |
|---|---|
| 1 4½-in. I-beam, 8 ft. @ 10½ lbs. | 84 lbs. |
| 2 tie plates, 12-in. x 6-in. x ½-in. | 20.4 " |
| 8 rivets | 2 " |
| Total | 106.4 " |

Concrete = 2.5 cu. ft. = .093 cu. yd.
Total weight of tie, 456 lbs.
M for beam = 43,000 inch-lbs.

heavier steel and cast-iron ties would cost more, say 15 cents; and the concrete ties, owing to their weight, would cost still more, say 18 cents.

Wooden ties have no value when worn out. The worn out steel tie, and the steel in the old concrete I beam tie would have a value as scrap. The cost of recovering the steel from the reinforced concrete tie would probably almost equal the value of the steel recovered, and we may therefore consider it of little value. The market price of such scrap varies, but considering the cost of marketing it, $10 per ton would be a liberal allowance.

In estimating the relative cost or economy of different ties, it is common to divide the first cost of the tie by the number of years' service it may be expected to give, and to call the quotient the annual cost of the tie. This is not correct and may lead to erroneous conclusions. Suppose that the first cost of a tie be $1, that its life be ten years, and that capital to buy the tie be borrowed at 4 per cent. The annual interest charge will be four cents. To repay the sum borrowed we may pay into a sinking fund each year a sum such that the various sums thus set aside, with four per cent. interest (which we assume the money will be able to earn) shall together amount, at the end of ten years, to $1. With the $1 we can then pay off the debt incurred to purchase the tie, and close the transaction, or we can purchase with it a new tie and put it in the place of the old one. This may go on during any number of tie-life periods, and at the end of any one of them we shall have in hand the $1 to pay off the original debt, and close the account.

During any such life-period the *annual* cost of the tie will be:

| | |
|---|---|
| One year's interest on $1.00 at 4% | $0.04 |
| One year's payment to the sinking fund | .0833 |
| And the total annual cost will be | $0.1233 |
| Whereas the $1.00 divided by ten years (neglecting interest) would equal, annually, only | $0.10 |
| But, if to this 10 cents we add the yearly interest charge, 4 cents, we shall have as the apparent annual cost | .14 |

Which is almost as much in excess of the correctly computed annual cost as the 10 cents is below it.

We have not here made any allowance for the possible value of the worn out tie. If it could be sold for ten cents as scrap, we should obviously have to provide for only 90 cents in our sinking fund to enable us to pay the debt incurred in the original purchase.

The annual cost of a cross-tie arrived at by the method outlined above is the most satisfactory unit by which to measure its economy. But the element of spacing in the track must also be considered. If we divide the cost of the tie by the distance from center to center of ties, we shall have the cost per linear foot of track, and thus reduce our results to *annual cost of ties per linear foot of track*, which is the true basis of comparison.

This annual cost per linear foot of track may be expressed algebraically thus:

Let x = the required annual cost of ties per linear foot of track.
c = the first cost in the track per linear foot of track.
v = the value of the worn out tie per linear foot of track.
L = the useful life of the tie in years.
i = the rate of interest = the interest on $1.00 for one year.
s = an annual payment into a sinking fund which at i rate of interest for L years will amount to one dollar (s can be taken directly from tables such as that on page 16 of Kent's Mechanical Engineers' Pocket Book).

Then $x = ci + (c - v)\ s$.
If $v = 0$, then $x = c\ (i + s)$.

Applying this formula to each of the kinds of ties we have considered, we may, for facility in comparing results, prepare a table like the following:

TABLE SHOWING DATA AND ANNUAL COST OF RAILROAD CROSS-TIES OF DIFFERENT KINDS.

| | Rate of interest, 4% | | | | | |
|---|---|---|---|---|---|---|
| | Wood | | | | Concrete | |
| | Untreated. | Treated. | Steel. | Cast-iron. | Reinforced. | Steel-beam. |
| Life of tie in years | 8 | 17 | 25 | 30 | 8 | 14 |
| Cost of tie delivered | $0.50 | $1.40 | $4.25 | $5.25 | $2.30 | $3.25 |
| Cost of renewal | .12 | .12 | .15 | .15 | .18 | .18 |
| Cost of tie in track | .62 | 1.52 | 4.40 | 5.40 | 2.48 | 3.43 |
| Value of worn-out tie | ... | ... | .85 | .75 | .20 | .53 |
| Spacing of ties, center to center, feet | 1.875 | 1.875 | 2.0 | 2.0 | 2.0 | 2.0 |
| Cost of ties per linear feet of track | 0.33 | 0.81 | 2.20 | 2.70 | 1.24 | 1.76 |
| Value of worn-out ties per linear foot of track | .... | .... | .42 | .37 | .10 | .26 |
| Annual cost of ties per linear foot of track | 0.049 | 0.067 | 0.131 | 0.149 | 0.173 | 0.152 |
| Annual cost for one mile of track | 258.72 | 353.76 | 691.68 | 786.72 | 913.44 | 802.56 |

The last line of this table tells the whole story, and little comment is called for. The lesson it conveys is that *no metal or concrete cross-tie capable of giving the same efficiency of service in track as the wooden tie can hope to compete with the latter at anything like present cost prices of each.*

By substituting different values in the equation given above we may obviously solve various problems relating to cross-tie economy. Thus, if we wish to know what must be the cost of untreated wooden ties to make them equal in annual cost to the steel tie, we may place x = $0.131 (the annual cost of the steel tie) and we shall have $c\ (i + s) = \$0.131$. Solving this for the value of c we find it to be $0.882, or, in other words, until the cost in the track of untreated oak or yellow pine ties shall exceed $0.88 per linear foot of track, they will be more economical to use than the steel tie. This price is equivalent to $1.65 per tie.

In like manner the following interesting conclusions, based on equal economy in use, seem to be justified:

1.—If the cost of creosoting ties be 90 cents each, it will not pay to resort to creosoting until untreated ties shall cost about 84 cents each.

2. When untreated ties cost 50 cents each and last eight years any treatment that will

just double their life must not cost over 57 cents each.

3.—Under the same conditions, as above, a treatment that will not add over 50 per cent. to the life of the tie must not cost over 36½ cents for each tie.

4.—Where the climatic conditions are such that untreated ties costing 50 cents each in the track, last only six years, any treatment that will double their life will pay if the cost be not over 39 cents per tie.

5.—If ties of inferior woods, costing 40 cents each, can by treatment, costing 90 cents, be made to last 16 years, they will be as economical as oak or yellow pine ties lasting eight years and costing 75 cents each.

6.—To be as economical as untreated wooden ties costing 62 cents in track and lasting eight years, a steel tie good for 25 years service must not cost over $1.85.

7.—Under the same conditions, a concrete tie lasting eight years must not cost over 81 cents, and a concrete-steel-beam tie lasting 14 years must not cost over $1.05.

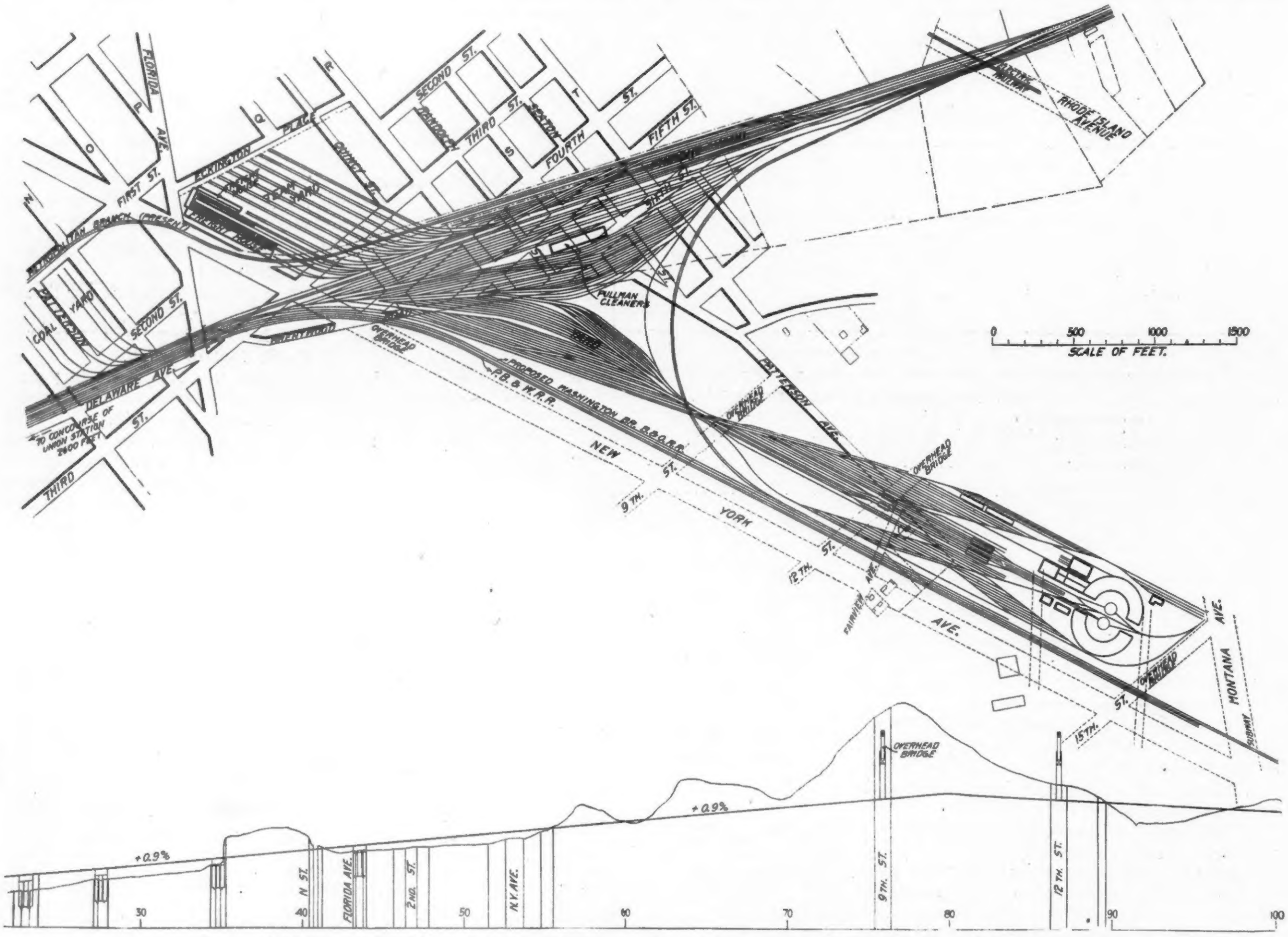
I need not multiply these deductions—any one interested can extend them indefinitely. Those above assume that the data of cost and life of the different kinds of ties are as I have estimated or assumed them to be. Whether they be accepted or not, the method here used to compare different kinds of ties with each other is, I believe, the correct one, and if so, each person can apply it to any data he may have, or any assumptions of cost and life of tie that he may think reasonable.

The Paris Metropolitan carried 80,000,000 passengers between January 1 and September 20, and the receipts were 14,000,000 francs, or $2,800,000; an increase over the same period of 1903 of 6,550,000 passengers carried and 1,200,000 francs in receipts. The length of the two lines operated is 24 kilometers.

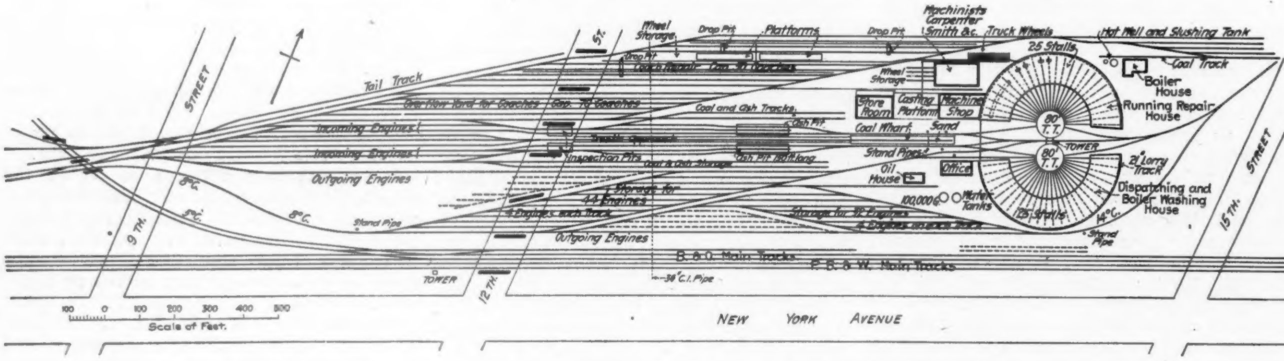
## New Yards and Terminal Approaches at Washington D. C.

BY W. F. STROUSE.*

The new union station at Washington, D. C., has already been fully described in the *Railroad Gazette*, Dec. 4, 1903, and Jan. 15 and June 3 of this year. In addition to the work on the station itself, the changes necessary in all of the yards and approaches of the Baltimore & Ohio and a part of the Pennsylvania's tracks have involved the handling of immense quantities of excavation and the construction of extensive masonry work for the approaches. The construction of this great piece of work has been divided between the Pennsylvania Railroad and the Baltimore & Ohio. Massachusetts avenue was made the dividing line and all work south of that street is being done




General Plan and Profile of, Yards and Approaches, Washington Union Station Improvements.




General Layout of Car and Engine Yard Terminal, Washington, D. C.

*Assistant Engineer, Baltimore & Ohio, in charge of construction at Washington.

by the Pennsylvania, and, with the exception of a connection of the Philadelphia, Baltimore & Washington near Winthrop Heights, all of the work north of Massachusetts avenue is being done by the Baltimore & Ohio.

The accompanying general plan shows the arrangement and extent of the new yards and other terminal facilities which are to be provided on the outskirts of the city. The approach tracks to the station are carried on a solid fill supported with masonry retaining walls. All of the streets between H street and Florida avenue have been carried under the tracks by depressing them from 11 ft. to 16 ft. below the former grade line. North of Florida avenue the streets will be treated as follows: Rhode Island avenue will be taken under; New York avenue, Ninth, Twelfth and Fifteenth streets will be taken over, as will also Montana avenue. An average fill of 20 ft will be required over the entire area occupied by the new terminal station, and this will be enclosed by retaining walls on the east and west sides. These walls are continuous from the Plaza in front of the station on out to M street, and range in height from 5 ft. to 35 ft. above the present surface of the ground. The retaining walls are of the ordinary section, being constructed of sandstone facing backed with Portland cement concrete. All of the foundations are of concrete, but the stone work is carried down from 12 to 18 in. below the surface of the ground. The west retaining wall between the station building and the heating plant, a distance of about 1,000 ft., encloses a subway in which the pipes and wires will be carried from one building to the other.

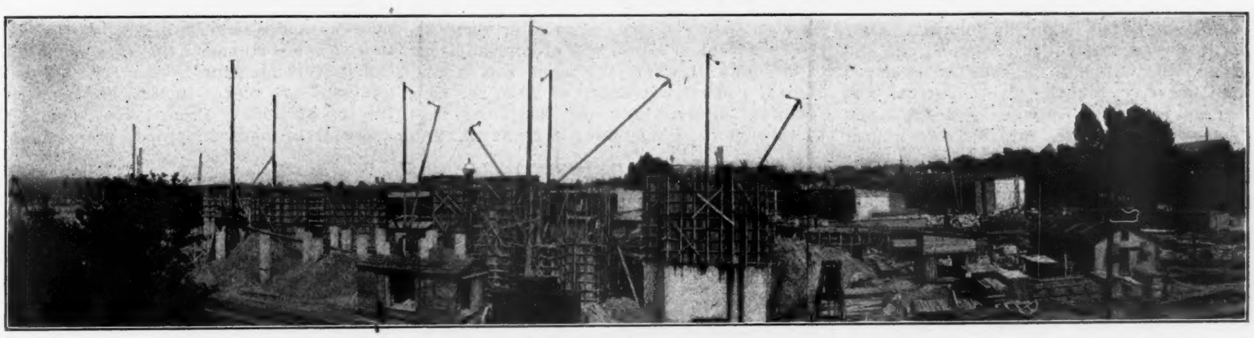
The bridges which carry the tracks over the streets are of somewhat unusual design. The distance between abutments in all cases is 80 ft. at right angles to the axis of the street. This distance is divided into three spans; a center span of 25 ft. and two side spans of 27 ft. 6 in., the tracks crossing the streets on a skew of 15 deg. 42 min. The center span is supported on two rows of columns and the superstructure consists of 24 in. I-beams spaced about 18 in. center to center. These beams are embedded in concrete carried down 2 in. below the bottom flange and surfaced on top flush with the top flange. Over this solid mass of steel and concrete is a layer of petroleum residuum ¾ in. thick, and on top of that is another layer of reinforced concrete about 6 in. thick, on which the ballast is laid. This will give a perfectly dry structure, it is thought, since the waterproofing is continuous over the whole bridge floor and is carried down on the rear face of the abutments.

As the shortest of these subway bridges will carry ten tracks divided into two groups of five each, it was necessary to provide expansion joints at intervals of about 30 ft. The construction of these joints is shown in one of the accompanying drawings. They will be thoroughly waterproofed to insure against dripping to the streets below. Because of the unusual length of these street subways under the tracks, which in one case is 790 ft., it was necessary to provide for lighting in some way, and also to ventilate them. Prismatic lights will be introduced in the roof between tracks, and, at one or two street crossings, openings 10 ft. wide by 80 ft. long have been provided near the center, so as to admit both light and air.

The abutment walls for supporting these street crossing bridges are of the ordinary construction except for special provisions which have been made for drainage. Gutters are constructed in the backs of all abutments with down spouts placed at frequent intervals which will be connected with the street sewers. The backs of the abutments

**Temporary Tracks at North End of Baltimore & Ohio Station.**

**Panoramic View of Terminal Station Site Looking North and Showing East Half of Foundations for Station Building.**

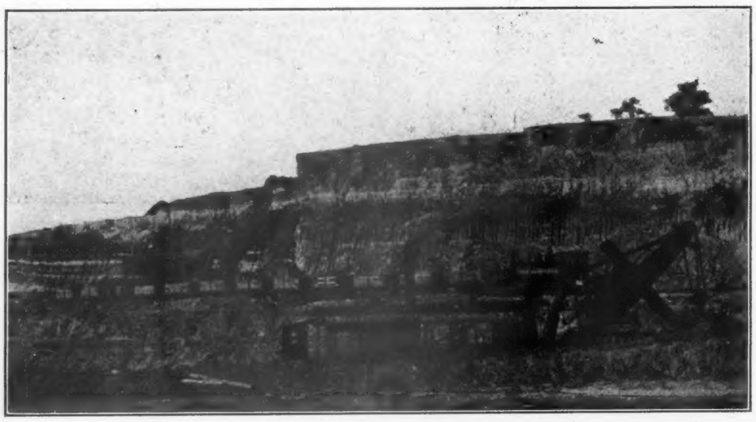


**Foundations for New Washington Union Station, Looking East.**

are covered with a layer of waterproofing ½ in. thick, applied on a thoroughly dry surface at a boiling temperature.

The construction of the long retaining and abutment walls on this work developed some methods not usually employed on average construction work of a similar nature. The work was also complicated by the presence of many railroad tracks and yards located in the center of, and all around, the construction site. Before starting work on the masonry a large cubical concrete mixer was installed near the intersection of the east wall and G street. A pit about 16 ft. wide and 40 ft. long was constructed about 100 ft. away from the mixer. Across this pit were laid two surface tracks which extended for a sufficient distance beyond the pit to provide storage for five or six cars containing material. One track was used for sand and the other for broken stone. Between the two tracks was located the cement house, one end of which extended up to within a few feet of the end of the pit.

West Retaining Wall between H Street and Terminal Station, Showing Subway.

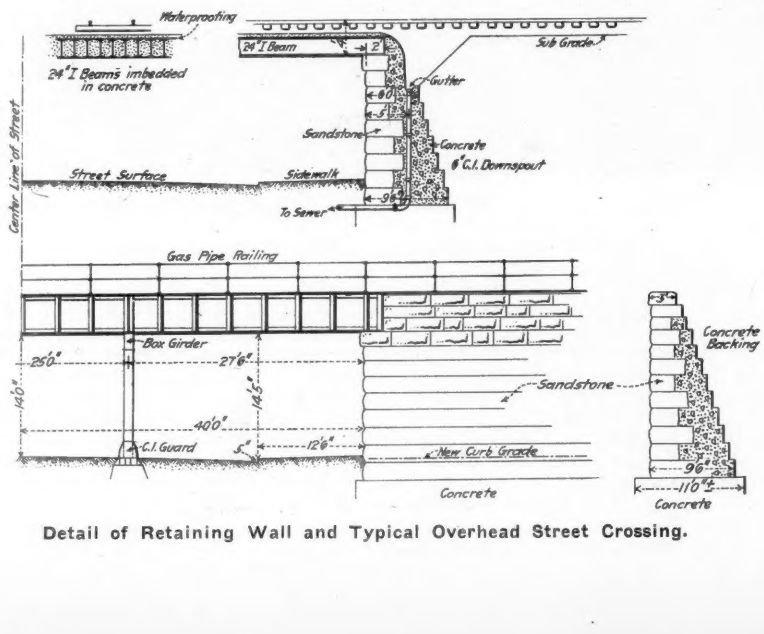


Steam Shovels Excavating 82-ft. Cut for Coach Yard.

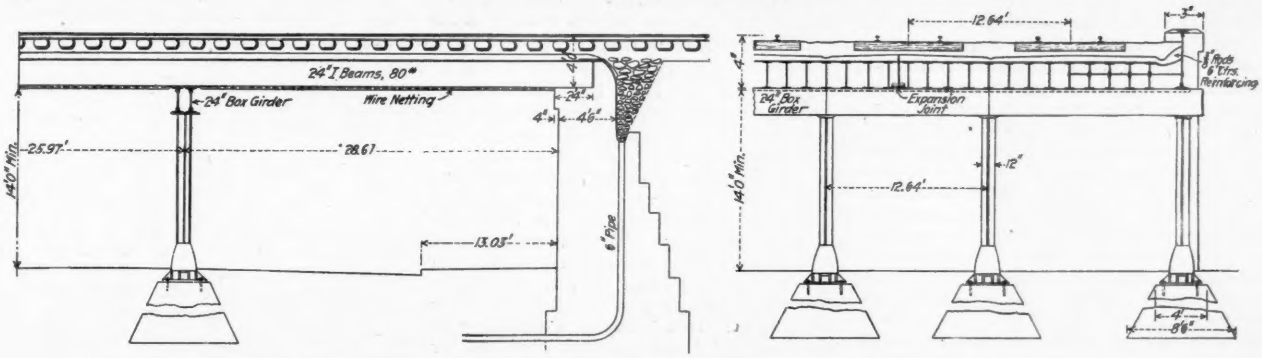
The cars containing the sand and stone were dropped down by gravity over the pit. A truck used for conveying materials to the mixer was first placed under the car containing sand and the proper quantity of sand dumped into it direct from the car. The truck was then moved to a point midway between the material tracks and the cement was added in proper quantity. After this it was moved under the stone car and the necessary amount of stone was dumped into it directly from the car. The truck was then hauled up an incline by a cable and automatically dumped into a large hopper above the mixer. While the car was being returned to the pit the material just deposited in the hopper was fed into the mixer. An automatic device was used for adding water in the mixer, and under ordinary conditions this gave very uniform results. When sufficiently mixed, the concrete was dumped into buckets, carried on small trucks and conveyed by horses or mules to the points where it was to be used. This plan worked satisfactorily as long as the shipments of material and progress of the work were approximately the same. In case of bad weather or any delay on the work which would bring together more material than could be disposed of within the time limit for releasing cars, the contractors, of course, were subjected to demurrage charges; but, owing to the simplicity and cheapness of the method of handling the material, a reasonable amount of demurrage could well be afforded. The greatest difficulty was experienced in midwinter, when for short periods of time masonry could not be laid because of the freezing temperature.

At the other mixer, installed near the intersection of the west wall and G street, the method of handling the material was somewhat different. An elevated double-track line of bins was constructed, one of which was used for sand and the other for crushed stone. Cars containing these two materials were run up on the tracks over the bins and dumped, and the cars were released within a few hours after their arrival. A cement house was erected adjacent to the bins in which the stone was stored, and the cement was unloaded from the cars standing on the track over the stone bins by throwing the bags down a chute through the roof of the house. A subway, about 6 ft. square, was built under each line of bins. The truck, used for conveying material, on returning from the mixer, first passed through the subway under the sand bins, where sufficient sand for a batch was taken from the bins by opening an aperture in the bottom by a simple lever device. The truck was then moved to the outer end of the bins to an automatic transfer table. It was then moved laterally to the track under the stone bins, where the stone was taken in the same manner as the sand above described. At the end of the bin, near the mixer, a hopper was arranged into which cement was placed in batch quantities. As the truck passed this point the cement was added. The truck was then taken up an incline by cable and dumped into a hopper, over the mixer. The quantities of materials were gaged by metal strips riveted to the sides of the trucks.

A Hains' gravity mixer was also installed in L street. The stone and sand used at this mixer were taken direct from drop bottom cars, placed in position on a trestle over L street, which had previously been depressed to the new grade. This material was dumped through the floor of the trestle into buckets, in which it was hoisted to the top platform of the mixer. The cement which was housed nearby was taken to the top of the mixer in the same manner. The method of mixing by this machine is peculiar. The stone and sand are placed in separate hoppers on the top platform. From these hoppers this material is taken in proper proportions by




Detail of Retaining Wall and Typical Overhead Street Crossing.



**Detail of Typical Street Crossing Bridge Showing Arrangement of Columns and Drainage.**

turning circular discs, having a quarter segment cut out, into four hoppers on the second platform. On this platform the cement and water are added. These hoppers are then all opened simultaneously and the mass is allowed to fall into one large hopper. It is then passed successively through three of the large hoppers into the bucket in which it is conveyed to the work. The principle upon which this machine works is suction; the center of the mass moving first and drawing the sides toward it.

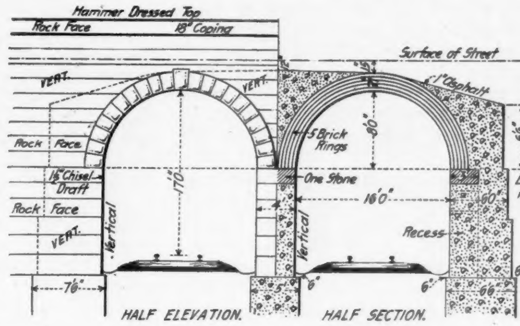
Another of these mixers was located on the site of the station building and was used to mix the concrete used in the foundations. The method of handling the crushed stone in this portion of the work was different from any above described. In this case the stone and sand were dumped from cars into bins under an elevated trestle. The bottoms of these bins were arranged as chutes, which were opened and closed by a form of cut-off, raised and lowered by hand. Certain bins were used for sand, others for stone. These materials were taken from the chutes into buckets which were hoisted to the top of the mixer by derricks. The cement house was so located that the bags were run down a chute, from the cars on the trestle, through the roof of the house.

The floor of the station was fixed at an elevation of 58 ft. above mean tide. This required the construction of foundations which extend from 30 to 38 ft. above the ground, requiring a most elaborate and intricate system of forms for moulding the concrete to the proper shape.

As so much of the masonry work consisted of long stretches of wall, traveling derricks were used in most cases, and, where possible, one rail of the derrick track was used as one rail of the track upon which the masonry material was handled. When the concrete foundations were in, the stone and concrete work were put up. A course of stone facing was laid, after which the concrete backing was rammed in place, in layers about 8 in. thick; each course being completed and allowed to set before another course was started. On work of this kind, this method gave the concrete time to set before the next course was started.

The forms used in putting up the concrete work, were of a very simple design. Small iron rods, having a nut on one end and a hook about 2 in. long on the other end were set in the top of each course, for the purpose of holding the forms for the next course in place. When the concrete was set, these rods were cut off.

As the space used by the Baltimore & Ohio for coal and team yards will be occupied by the terminal depot, it was necessary to provide for these facilities at some other point. The site selected for the new coal yard is located between First and Second, and M and N streets. In this space six lines of trestle, each about 600 ft. long and 18 ft. high, were built, having a capacity, in all, of about 60,000 tons. The driveways are 33 ft. wide, one for each trestle, and are macadamized. The bins cover three-fifths of the total area of the block, while the driveways cover the remaining two-fifths. The trestles are all constructed level, but owing to the grade of First street and of the terminal tracks on Delaware avenue, it was found necessary to construct the yard on a 1 per cent. grade, transversely descending toward M street. A system of tile drains will drain the yard and driveways.



**Portal and Half Cross-Section of Pennsylvania Tunnel under Capitol Hill.**

A new freight terminal was constructed at New York and Florida avenues, which is perhaps as complete a layout as can be found for handling a business such as Washington furnishes. About 80 per cent. of the business of this city is inbound. Washington is not a producing city, as factories are discouraged to such an extent that few exist. The rapid growth of the city and the substantial character of most of the construction, makes it a large market for all kinds of building material, which is handled in car-load lots.

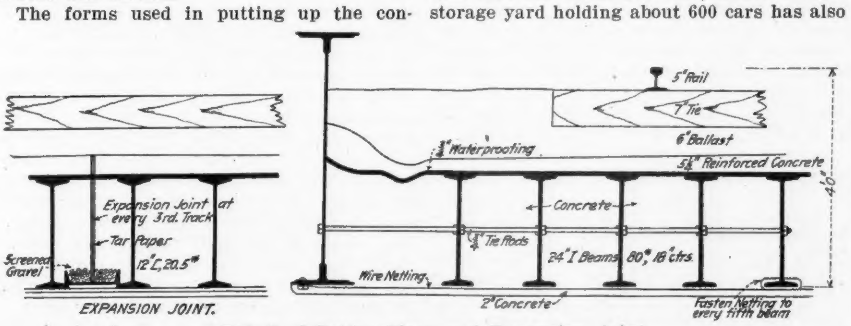
In view of these conditions, team or bulk unloading tracks were provided to accommodate about 450 cars, while the house tracks will care for about 200 cars, and a freight storage yard holding about 600 cars has also been provided. The team and house tracks are divided into three groups, each having a switching track, of some length, which will permit several yard engines to work the groups without interference. The storage yard is divided into three sections, so arranged that the switching can be done with the least interference.

East of the freight terminal are located the joint passenger coach yard, roundhouse, shops, engine yards and repair tracks. Two tracks, between the terminal yard and the roundhouse, are set aside for handling engines and cars between the station and the coach yard, and roundhouse, without interfering with the movement of trains over the main passenger tracks. They are located between the Washington and Metropolitan Branches, and pass under the "Y" connection of these two lines.

At Florida avenue all tracks are at the same elevation. From this point north and eastward the grades of the groups of tracks are as follows: The Washington Branch connection of the Baltimore & Ohio and the Magruder connection of the Pennsylvania ascend at the rate of 0.9 per cent., the coach yard tracks at 0.5 per cent., and the Metropolitan Branch connection of the Baltimore & Ohio at 0.7 per cent. These differences in grades are due largely to the natural contour of the ground and served to permit an easy overhead crossing of the "Y" connection between the Metropolitan and Washington Branches over the equipment tracks, which are constructed on the same grade as the coach yard, southwest of the "Y," but which have heavier grades north of it.

From a construction standpoint heavier grades would have been preferable on all the different groups of tracks, as about 2,250,000 cubic yards of earth will have to be removed to bring the space assigned as a passenger coach storage yard to the proper grade.

A better idea of the magnitude of this work may be had, when it is stated that the material, over a considerable area, has to be removed to a depth of 82 ft., and that



**Detail of Bridge Floor and Expansion Joint.**

about 75 acres of ground will be occupied by these yards. Six large steam shovels, each having a capacity of about 30,000 cubic yards per month, are engaged on the work, and to date, have moved about a million cubic yards of material, practically all of which has been wasted. Quite a large percentage of this material was hauled nearly two miles from the point where it was excavated. Practically all of the remaining material will be used to fill in the terminal space and the plaza. Should there be any material left after this work is done it will be used to fill property now owned by the railroad company around the plaza, which will be 30 to 35 ft. above the present ground level.

As designed, the coach yard will have a capacity of at least 600 cars. The roundhouse and shop layout has been carefully designed, and the arrangement will be quite convenient and complete. The engine house, it will be noted, will be constructed in two sections of 25 stalls each, both sections having a turn-table. The coaling plant will consist of storage bins with measuring devices, and is located between the ash pits and the roundhouse; the approach to the storage bins will be by the ordinary trestle incline. The coal will be delivered in the bins direct from drop bottom cars, the cost of handling being very small. This style of coal wharf requires more room than a mechanical device, but is cheaper both in first cost and operation. The general construction of the ash pits will be very similar to ordinary practice, but the ash track will be depressed enough to permit loading the cars by shoveling the ashes over an adjustable apron, the top of the car being below the bottom of the engine pit. Inspection pits are also provided and are reached just before going on the ash pit, where the engines can be examined before turning them into the house.

The track arrangement will be such that access to both tables can be had from both sides of the coal wharf and from both tables to the storage yard. A tail track is provided for moving engines to the storage yard without fouling inbound tracks. Shop facilities will be provided for making light repairs to cars and engines, and the necessary tracks, platforms, etc., will be installed.

The contract for grading the site of the new coal yard and the new bulk freight yard estimated at 100,000 cu. yds. and 50,000 cu. yds. respectively was let to Stewart & Wilmoth. The grading and masonry contract for the northern approach was let to McMullen & McDermott and to the Hoffman Engineering & Construction Company. In this contract the estimated quantities were 2,600,000 cu. yds. of excavation and 100,000 cu. yds. of masonry. The Thompson-Starrett Company, of New York, obtained the contract for the foundations and superstructure of the new Terminal Station building with the exception of the steelwork and interior decorating. The New York Continental-Jewell Filtration Company is building the tunnel under Capitol Hill which will connect the Pennsylvania with the new station.

In the preparation of this article the author is indebted to D. H. Burnham & Company, Architects, Chicago, for information in regard to the station building; to Mr. Robt. Farnham, Jr., Assistant Engineer, P., B. & W. R. R., and to the members of his staff for photographs of the works.

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The Wurtemberg State Railroads have had a surgeon's car built and equipped with all necessary appliances for the care of victims of railroad accidents, held ready to go anywhere on receipt of a telegram.

## Tests of Locomotives on the French State Railway.*

(*Continued from page 486.*)

In the original series of articles, the figures obtained from the tests are given in considerable detail and the results for each engine are examined individually, the operation of the steam being followed carefully from its passage through the throttle to its exhaust to the stack. Analyses are given of the wire-drawing of the steam in the steam pipes and during admission, of the expansion of the steam and of the coal and water consumption. In conclusion a summary of the results of these analyses is given for the purpose of comparing the performances of the different types of engines. The following is an abbreviated translation of the summary.†

*Summary of Results.*—The tests were made on the following locomotives:

1. No. 2,617. Single expansion 2-4-2 type with Bonnefond trip valve motion, having the exhaust independent of the admission, and a constant compression of about 10 per cent. Boiler pressure 185 pounds. Driving wheels 79½ in. diameter.
2. No. 2,754. Single expansion 4-4-0 type, with Ricour piston valves. Boiler pressure 200 pounds. Driving wheels 79½ in. in diameter.
3. No. 2,901. American single expansion 4-4-2 type, with piston valves. Boiler pressure 213 pounds. Driving wheels 84 in.
4. No. 2,802. American Vauclain compound 4-4-0 type. Boiler pressure 213 pounds. Driving wheels 84 in. in diameter.
5. No. 3,729. De Glehn four-cylinder compound 4-6-0 type. Boiler pressure 213 pounds. Driving wheels 69 in. in diameter.

The French locomotives have throttles of the double slide valve type while the American engines are fitted with double seated balanced poppet valves, which have the advantage of being very easy to operate, and giving an easy control of the amount of the opening. The poppet valve may, however, be criticised as being less steam tight than the slide valve, and more difficult to fit. Engines 2,754 and 2,901 are fitted with the single valve link motion and consequently, the control when working must be chiefly dependent on the throttle. Hence under ordinary working conditions the engine is run with the throttle not fully opened, and the steam chest pressure under these conditions is several pounds less than the boiler pressure. The tests show that the efficiency rises with the steam chest pressure and that when the pressure is down to 60 or 70 lbs. the steam consumption per horse-power hour is about 40 per cent. greater than when 140 to 160 lbs. pressure is carried. With a special valve motion as on engine No. 2,617, or better still, with compound cylinders, the engine can be run with the steam chest pressure in the neighborhood of the boiler pressure, thus securing a higher efficiency.

The steam chest pressure shows but slight variations during the stroke, except on the de Glehn engine No. 3,729. The variation of pressure on this engine is due to the small volume of the steam pipes, which is only 3.4 times the volume of the cylinder, while on the other engines the volume between the throttle and the high-pressure cylinder is from 4.4 to 5.4 times the cylinder volume.

Table 2 gives figures showing the wire-drawing during admission. In column two are the maximum port-openings for ordinary cut-offs and in column three the "factor of wire drawing," or the ratio of the fall of pressure during admission to the original steam chest pressure. The average port opening during admission is approximately two-thirds of the maximum port opening. It will be seen from the table that there is considerable wire-drawing in engine No. 3,729 (de Glehn), and even more in No. 2,754 (Ricour piston valve), as compared with the Bonnefond and the two American locomotives.

In its path from the boiler to the exhaust the steam encounters many obstacles, and consequently as the speed of the engine increases the tractive effort falls off. Table 3 shows the tractive efforts of the five engines calculated for a boiler pressure of 170 lbs. per sq. in., at speeds of 30 and 60 miles an hour. Column five gives the percentage of fall in the tractive effort when the speed is increased from 30 to 60 miles an hour. Engine No. 2,617 (Bonnefond trip motion) shows the most rapid fall of power. This is due to the defective action of the trip motion at speeds exceeding 50 miles an hour. Then comes the de Glehn compound No. 3,729, but it must be remembered that this engine has driving wheels only 69 in. in diameter. Next is the single expansion, No. 2,754, with Ricour piston valves, and the two American engines, which owe their superiority to their large ports.

The highest back-pressure is shown by engine No. 2,754, on which the piston valves are too small in diameter. The back-pressure is a little lower on No. 2,617 (Bonnefond trip motion) and on the two American engines, which do not have variable exhausts. The de Glehn engine, No. 3,729, is superior to all of the others in this respect, the back pressure being at least one-third less. It should be mentioned that this engine can maintain steam with the variable exhaust full open.

The fall of pressure in the intermediate receiver, that is to say the average distance between the high-pressure exhaust line and the low-pressure admission line, is about the same in the Vauclain and the de Glehn compounds. This fall of pressure which at high speeds amounts to 10 or 15 pounds, represents a considerable loss of work.

The steam consumption per horse-power hour as calculated from the indicator diagrams, is dependent on the pressure at admission and on the amount of the expansion. This is illustrated by the figures in table 4. All of the trains are passenger trains of about the same speed, with the exception of No. 1,428, which is a fast freight. The figures given for the indicated steam consumption are obtained by averaging the figures from the individual diagrams, which is a method sufficiently accurate for the present purposes of comparison. The number of expansions is obtained by dividing the final volume of a single cylinder by the initial volume occupied by the steam when admission ceases. For the compounds, the final volume is that of the low-pressure cylinder, and the initial volume is that of the steam admitted to the high-pressure cylinder.

The two compound locomotives show the lowest indicated steam consumption, which varies according to the working pressure from 15.5 to 18 pounds of steam per horse-power hour. Engine No. 2,617, with the trip valve gear, comes next to the compounds with slightly over 18 pounds per horse-power. On engine 2,901 leakage of the piston valves after cut-off increases the steam consumption; with steam tight valves this engine would show about the same consumption as No. 2,754, that is to say, a little less than 20 pounds of steam per horse-power hour.

The weight of steam lost by cylinder con-

*Abstract of articles by Mr. Joseph Nadal, Chief Assistant Engineer of Motive Power and Equipment, French State Railway, appearing in the Revue Generale des Chemins de Fer for May, 1903, and March and September, 1904. Translated by Lawford H. Fry.

†Throughout the present article all opinions expressed and all conclusions arrived at are those given by Mr. Nadal in the original articles.

densation was calculated for each engine by the formula previously given. The amount of cylinder condensation in a locomotive depends on the area of the metallic surface in contact with the live steam, and on the difference between the admission and the exhaust temperatures. Table 5 shows these factors for the engines tested and summarizes the results obtained by the application of the formula. There is not much difference between the clearance surfaces in the different engines, but it is less for the compounds than for the single expansion engines, as the diameter of the high-pressure cylinder is less than the diameter of the equivalent single expansion cylinder. The temperature range is less in the compounds but is not quite reduced by one-half, as the working pressure is not the same and the fall of temperature is not divided equally between the high and the low-pressure cylinder. The cylinder condensation losses, with trains of the same speed, varies but slightly with the amount of power developed, and consequently the loss per horse-power hour is least when the engine is developing the greatest power. In table 5 engine No. 2,802 (Vauclain compound) makes a slightly better showing than No. 3,729 (de Glehn compound) because the fall of temperature is more evenly divided between the two cylinders. Engine No. 2,617 (Bonnefond trip motion), which has the smallest clearance surface, gives only slightly more cylinder condensation than the compounds.

The formula for the loss by cylinder condensation can be checked by comparing the calculated steam consumption with the actually measured water consumption. The measured water consumption includes the steam required for the air pump as well as that used by the cylinders, while the calculations only give the steam used by the cylinders. There should therefore be a difference of about 3 per cent. between the calculated and the measured figures, and any greater difference must be due to moisture in the steam or an error in the calculation of the cylinder condensation. Table 6 shows the steam consumption figures for the locomotives under test. It will be seen that the calculated figures agree closely with those obtained by direct measurement except in the case of engine 2,802. The want of agreement in this case can be explained by an examination of the figures given in table 7 for the evaporated power of the coal. In engine 2,802 one pound of coal evaporated a little over eight pounds of water, while in the other engines the evaporation of a pound of coal was in the neighborhood of seven pounds of water. It is hardly likely that the evaporative power of the coal should be so much greater in one case than in the others, and the natural conclusion is, that engine 2.802 primed excessively and that the figure given for evaporation really represents an evaporation of 7 pounds of dry steam, which carries with it 1 pound of water. This would give 12.5 per cent. of moisture in the steam which with 3 per cent. added for the air-pump losses, is very nearly the figure shown.

Table 6 shows that if the formula for cyl-

*Table I.*

Dimensions and Types of Locomotives Under Test.

| | | | | | |
|---|---|---|---|---|---|
| Number | 2617 | 2754 | 2,901 | 2802 | 3729 |
| Nationality | French. | French. | American. | American. | French. |
| Type | 2-4-2 | 4-4-0 | 4-4-2 | 4-4-0 | 4-6-0 |
| Expansion | Single. | Single. | Single. | Compound. | Compound. |
| Valve | Corliss. | Piston. | Piston. | Piston. | Slide. |
| H.-p. cylinders, diameter, inches | 17⅜ | 16½ | 17 | 13 | 13¾ |
| L.-p. cylinders, diameter, inches | .. | .. | .. | 22 | 21⅝ |
| Stroke, inches | 25¼ | 25½ | 26 | 26 | 25¼ |
| Driving wheels, diameter, inches | 79½ | 79½ | 84 | 84 | 69 |
| Boiler pressure, lbs. per. sq. in. | 185 | 200 | 213 | 213 | 213 |
| Flue heating surface, sq. ft. | 1,205 | 119 | 171 | 129 | 130 |
| Fire-box, heating surface, sq. ft. | 103 | 1,582 | 1,721 | 1,571 | 1,697 |
| Total heating surface, sq. ft. | 1,308 | 1,701 | 1,892 | 1,700 | 1,827 |
| Grate area, sq. ft. | 20.5 | 21.5 | 35.0 | 25.6 | 25.6 |
| Weight on drivers, pounds | 63,000 | 64,800 | 75,000 | 72,300 | 95,000 |
| Weight, engine, pounds | 106,700 | 110.000 | 143,300 | 120,800 | 131,000 |
| Weight, engine and tender, pounds | 154,000 | 203.000 | 216,000 | 176,000 | 203,000 |

Note: The heating surface is measured on the inside of fire-swept side of fire-box and flues. Engines 2754 and 3729 have Serve ribbed flues.

*Table II.*

| Engine No. | Maximum port opening in sq. ins. under ordinary conditions of cut-off. | Wire-drawing factor for a speed of 50 miles an hour and average cut-off. |
|---|---|---|
| 2617 | 9.2 to 12.5 | 0.20 |
| 2754 | 3.0 " 5.3 | 0.38 |
| 2901 | 7.5 " 8.7 | 0.25 |
| 2802 | 11.5 " 18.2 | 0.20 |
| 3729 | 3.7 " 6.5 | 0.33 |

Note: The "wire-drawing factor" is the fraction of the steam chest pressure which is lost by wire-drawing during admission.

*Table III.*

| Engine No. | Average cut-off in per cent. of the stroke. | Indicated tractive effort in pounds: At 30 miles per hour. | At 60 miles per hour. | Percentage of reduction in the tractive effort when the speed is increased from 30 to 60 m. p. hr. |
|---|---|---|---|---|
| 2617 | 20 | 6,500 | 3,200 | 50.8 |
| 2754 | 25 | 5,730 | 4,200 | 27 |
| 2901 | 25 | 6,830 | 5,400 | 21 |
| 2802 | 50 | 7,160 | 5,620 | 21.5 |
| 3729 | 40 | 7,060 | 3,640 | 48.4 |

Note: The last column shows the reduction in the tractive effort when the speed is increased from 30 to 60 miles an hour.

*Table IV.*

Indicated steam consumption per horse-power hour, showing its connection with the steam chest pressure and the ratio of expansion.

| Engine No. | Train number and date. | Average: Steam chest pressure, lbs. per sq. in. | Cut-off in per cent. of the stroke. | No. of expansions. | Average indicated steam consumption per h. p. hour |
|---|---|---|---|---|---|
| 2617 | 86 June 5, '02 | 163 | 22 | 3.8 | 18.52 |
| | 86 June 6, '02 | 174 | 22 | 3.8 | 18.41 |
| 2754 | 86 Oct. 24, '02 | 157 | 28.5 | 2.86 | 19.10 |
| | 98 July 1, '02 | 152 | 29 | 2.82 | 20.65 |
| 2901 | 86 Oct. 29, '02 | 160 | 27 | 3.0 | 20.77 |
| | 86 Oct. 30, '02 | 137 | 26 | 3.1 | 21.45 |
| 2802 | 86 May 9, '02 | 146 | 55 h. p. | 4.45 | 18.05 |
| | 86 May 14, '02 | 203 | 40 h. p. | 5.50 | 15.51 |
| 3729 | 98 May 12, '03 | 174 | 40 h. p. | 4.8 | 16.10 |
| | 86 May 22, '03 | 185 | 45 h. p. | 4.4 | 17.60 |
| | 1428 June 3, '03 | 198 | 45 h. p. | 4.4 | 16.00 |

*Table V.*

Amount of cylinder condensation.

| Engine No. | Area of clearance space in square inches. | Train number and date. | Change in temperature of the steam in degrees Fahrenheit. | Weight in pounds of steam condensed per h.-p. hour. | Total weight in lbs. of steam condensed per hour. |
|---|---|---|---|---|---|
| 2617 | 874 | 86 June 5, 1902. | 134 | 6.17 | 3,530 |
| | | 86 June 6, 1902. | 132 | 5.66 | 3,280 |
| 2754 | 929 | 86 Oct. 24, 1902. | 128 | 8.86 | 4,030 |
| | | 98 July 1, 1903. | 125 | 7.56 | 4,090 |
| 2901 | 1,120 | 86 Oct. 29, 1902. | 134 | 7.28 | 4,470 |
| | | 86 Oct. 30, 1902. | 126 | 6.63 | 3,620 |
| 2802 | 1,070 | 86 May 9, 1902. | 68.5 | 4.20 | 3,360 |
| | | 86 May 14, 1902 | 76.5 | 4.65 | 3,370 |
| 3729 | 960 | 98 May 12, 1903 | 93 | 5.97 | 3,030 |
| | | 86 May 22, 1903 | 96 | 5.47 | 3,950 |

*Table VI.*

Comparison of steam consumption as shown by the indicator and as actually measured.

| Engine No. | Actual weight of water used per horse-power hour. | Calculated weight of dry steam used per horse-power hour. | Percentage of difference between the actual and the calculated steam consumption. |
|---|---|---|---|
| 2617 | 26.45 lbs. | 25.44 lbs. | 4.6 |
| 2754 | 29.80 " | 27.50 " | 7.7 |
| 2901 | 29.63 " | 28.37 " | 4.4 |
| 2802 | 26.67 " | 22.33 " | 16.2 |
| 3729 | 23.59 " | 22.58 " | 4.3 |

*Table VII.*

Evaporative Duty of the Locomotives.

| No. of engine. | Pounds of water evaporated per lb. of coal. | No. of engine. | Pounds of water evaporated per lb. of coal. |
|---|---|---|---|
| 2617 | 7.16 | 2802 | 8.00 |
| 2754 | 6.78 | 3729 | 7.27 |
| 2901 | 6.66 | | |

*Table VIII.*

Resistance of locomotives and tenders, in relation to Speed.

| Engine No. | Average weight in tons of 2,000 lbs.: Engine. | Tender. | Total. | Formula for resistance. | Resistance in pounds per ton of loco. and tender at 50 miles per hr. | Tractive effort required by loco. and ten. at 50 miles per hr. |
|---|---|---|---|---|---|---|
| 2617 | 53 | 24 | 77 | $R = 7.6 + 0.157\,V + 0.00362\,V^2$ | 23.9 lbs. | 1,840 lbs. |
| 2754 | 55 | 46 | 101 | $R = 7.6 + 0.085\,V + 0.00342\,V^2$ | 20.4 " | 2,060 " |
| 2901 | 72 | 36 | 108 | $R = 7.6 + 0.085\,V + 0.00342\,V^2$ | 20.4 " | 2,200 " |
| 2802 | 60 | 28 | 88 | $R = 8 + 0.097\,V + 0.00517\,V^2$ | 25.8 " | 2,270 " |
| 3729 | 65 | 36 | 101 | $R = 8 + 0.097\,V + 0.00517\,V^2$ | 25.8 " | 2,600 " |

Note: R = resistance of locomotive and tender in pounds per ton.
V = speed in miles per hour.

*Table IX.*

Characteristic factors of the locomotives.

| Class. | Engine No. | Factor 1.: Weight on driving wheels. | Maximum tractive effort, | Factor of adhesion. | Factor 2.: Normal weight of steam produced per hr. | Ratio of weight of locomotive to weight of steam produced per hr. | Normal weight of coal burnt per sq. ft. of grate pr. hr. | Factor 3.: Steam used per horse-power hour. | Normal horse-power. | Weight of engine without tender per horse-power. | Normal indicated tractive effort at 50 miles per hr. | Factor 4.: Coefficient of efficiency at 50 miles per hour. | Steam used per hr. per horse-power effective per hour. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Single expans. | 2,617 | 65,000 | 15,700 | 4.28 | 16,200 | 6.58 | 1,200 | 25.44 | 640 | 166.5 | 4,760 | 0.605 | 42.03 |
| Single expans. | 2,754 | 64,800 | 14,800 | 4.37 | 18,600 | 5.92 | 1,300 | 27.55 | 675 | 163.0 | 5,030 | 0.591 | 46.56 |
| Single expans. | 2,901 | 75,000 | 16,900 | 4.44 | 24,400 | 5.53 | 1,150 | 28.40 | 915 | 156.5 | 6,810 | 0.678 | 41.84 |
| Compound | 2,802 | 72,300 | 14,800 | 4.90 | 20,500 | 5.90 | 1,230 | 22.33 | 910 | 133.0 | 6,780 | 0.666 | 33.49 |
| Compound | 3,927 | 95,000 | 18,100 | 5.24 | 21,000 | 6.22 | 1,270 | 22.58 | 930 | 140.5 | 6,930 | 0.625 | 36.11 |

inder condensation is correct there cannot (except in the one case) be much moisture in the steam, and on the other hand if the steam can be shown to be free from moisture the figures obtained from the tests prove that the cylinder condensation formula gives correct results.*

American locomotives have the reputation of being less economical than those of Europe, and this reputation appears to be justified by the results given by those on the French State Ry., at least when they were first put into service. The following conclusions apply, of course, only to those American locomotives of which we have been able to follow the operation, and it would be dangerous to generalize from our conclusions. The causes of low efficiency in a locomotive may be grouped under the following headings:

1. Low boiler efficiency whether due to poor combustion or evaporation; priming.
2. Boiler leaks.
3. Defective utilization of the steam in the cylinders.
4. Leakage at the slide valves.
5. Interior resistance of the machine.

1. The American locomotive No. 2,901 shows the lowest rate of evaporation per pound of coal, in table 7, while on the other hand the American engine No. 2,802 shows the highest evaporation. It has, however, been explained previously that this apparently high figure is really due to priming. In reality the efficiency of the American boilers is less than that of the French boilers, this being chiefly due to the arrangement of the exhaust which has a double nozzle and is not variable. The American engines often prime considerably on account of the small surface of the water in the boiler and of the restricted volume for steam above the water. These drawbacks are due to the elevated position of the boiler.

2. The boiler is constructed of material of excellent quality; but its construction, doubtless owing to the high cost of American labor, is not very careful. Leakages at seams, staybolts and tubes are very frequent.

3. The operation of the steam in the cylinders would be as economical as in European engines if the running conditions would allow of steam chest pressures of 130 or 140 pounds per sq. in., which would mean a cut-off at 20 or 30 per cent. of the stroke. It appears that in America it is usual to cut-off at 40 or 50 per cent. This does not give sufficient expansion and consequently the steam consumption is high.

4. All of the American slide valves whether of the D or piston type are balanced. This is advantageous on account of the reduction in friction, and with the modern increase in steam pressures balancing appears to be becoming more and more necessary. Unfortunately balanced slide valves are rarely steam tight. In particular the piston valves of the American engines Nos. 2,802 and 2,901 soon become leaky, as they are only provided with the ordinary cast-iron piston packing rings. The openings in the rings increase in size, and if the valve head does not fit the steam chest exactly, leakage direct to the exhaust is permitted. The steam-chest bushings wear rapidly near the edges of the ports and the admission of the steam is not entirely intercepted at the point of theoretical cut-off, but goes on during the expansion or even later, according to the amount of wear. The Vauclain compound No. 2,802 has for the co-ordinated high and low-pressure cylinder only one valve, which is composed of four cylindrical slide valves mounted on one stem. This arrangement is simple, but of a nature to permit leakage. The steam chest bushing is perforated with many openings, and it is difficult to adjust it so as to bear at all points. Consequently there are often leakages of steam behind the bushing which are difficult to discover.

5. We have remarked in regard to the boiler that the American workmanship is not particularly careful. This may be said of the whole engine. Now if the various parts and particularly the valve motion, are not properly fitted, the interior resistance of the engine will be increased and the efficiency at the drawbar reduced.

The average resistance per ton weight of engine and tender varies considerably with the type of engine. The tests made enabled the resistance of the different engines to be determined, and formulæ were developed which give the average resistance per ton of engine and tender in relation to the speed. These formulæ are collected in table 8, together with the weight of the engine and tender, and the tractive power required to move the engine at a speed of 50 miles an hour.

The character of a locomotive may be judged from the factors which are given below.

1. *Factor of Adhesion.*—This is the weight on the driving wheels divided by the maximum tractive effort. The maximum tractive effort, which is usually only developed on starting, may be calculated for the formula

$$\frac{0.85\ P\ d^2\ s}{D}$$

where P is the maximum difference of pressure on the two sides of the piston (in a single expansion engine this is the boiler pressure).
d is the cylinder diameter.
s is the stroke.
D is the driving wheel diameter.

Indicator diagrams taken during the tests show that the coefficient 0.85 is correct.

2. *Factor of Evaporation.*—This is calculated by the formula $Q = 201 \sqrt{G\,(F + \frac{1}{6} T)}$ where

Q is the weight of water evaporated in an hour in pounds.
G is the grate area in square feet.
F is the fire-box heating surface in sq. ft.
T is the inside tube heating surface in sq. ft.

Under favorable conditions the evaporation can be forced for a short time to about 20 per cent. above the figure given by this formula.

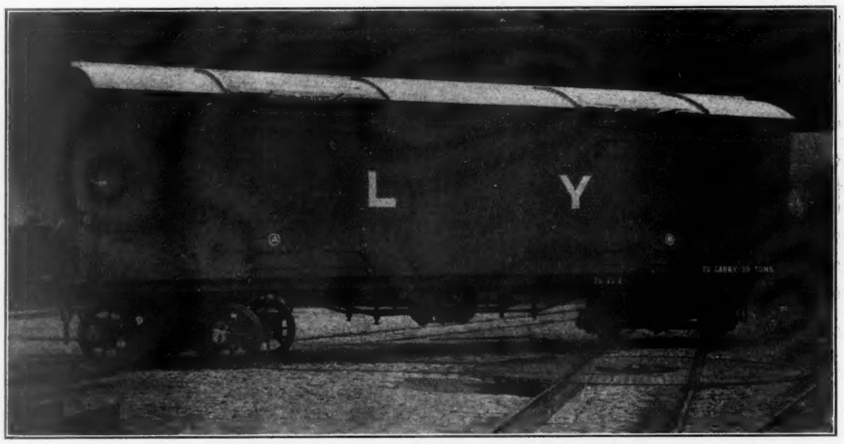
3. *Factor of Steam Consumption.*—This is the indicated steam consumption per horse-power hour calculated at the normal speed, which is the case on the engines under consideration is about 50 miles an hour. From factors 2 and 3 can be calculated the horse-power which can be developed under ordinary running conditions.

4. *Factor of Drawbar Efficiency.*—This factor is calculated for the normal horse-power and also for conditions of lighter service. If the steam consumption is divided by the factor of efficiency, the result gives the steam consumption per horse-power hour effective at the drawbar. These factors and their derivatives are collected in table 9.

*Mr. Nadal quotes a number of authorities as to the quality of the steam produced in a locomotive boiler and bases a considerable calculation on the results obtained with superheated steam, to show that under ordinary conditions the steam is practically dry and that consequently the results of the present tests establish the accuracy of the cylinder condensation formula.

## Long Cars in English Freight Houses.

Necessity is the mother of invention, and those English railroads which in the past few years have been introducing long freight cars have ingeniously solved what seemed a rather difficult problem—that of moving these cars into and out of freight houses and small freight yards, (designed in every part to accommodate only short cars) where the house tracks are at right angles to the main leads. As is well known, the ordinary short car is run from one of these tracks to the other by means of a turntable about 13 ft. in diameter, often worked by hydraulic power. In a situation like this, the feelings of the ordinary long freight car must be highly embarrassing, assuming that it has feelings. On the Lancashire & Yorkshire, however, the problem appears to have been settled very simply, as is shown by the accompanying illustration. The front truck of the car has been turned and started a few feet toward the interior of the shed, and the rear truck is being run on to the table. The running of long cars into a house, in this way, implies that those other obstacles, structures very close to tracks on sharp curves, do not exist in this particular case.




Turning a Long Car in an English Freight House Yard.

The car shown is one of a number which the Lancashire & Yorkshire has recently put into service. It has a capacity of 30 tons and is 35 ft. long, 8 ft. wide over all, and 7 ft. 10½ in. high inside, with a cubic capacity of 1,960 cu. ft. The underframe is steel but the body framing is wood, sheathed on the inside as well as the outside to prevent damage to lading by projections on the framing. Two double-hinged doors, 6 ft. 6¼ in. high x 5 ft. 1 in. wide are provided on each side, and the section of the roof immediately over the doors is formed by a removable tarpaulin so that the car can be loaded or unloaded with a crane. The cars are mounted on diamond arch-bar trucks of the usual form, and are fitted with circle plates, so arranged that they can be turned completely around. With

this arrangement the car can be turned on an ordinary small turn-table in two operations by giving each truck a quarter turn. The car is fitted with both hand and vacuum brakes, but the brake rods instead of being attached to the truck levers in the usual way are carried in to the center of the truck and then down so that the brakes can be applied when the trucks are in any position. The tare weight of these cars is 33,300 lbs.

## Mr. Platt's Review of Automatic Block Signaling.

The Bulletin of the International Railway Congress for September contains a report by Mr. C. H. Platt, former General Superintendent of the Western District of the New York, New Haven & Hartford, on automatic block signals, prepared for the seventh session of the congress; and his theme is "recent improvements in apparatus and progress in the introduction" of such signals. The report covers America alone.

Mr. Platt briefly reviews the discussions of this subject at former meetings of the congress, and then gives detailed descriptions of those improvements in signal mechanisms and signal circuits which appeared in the four years up to September, 1903. These include the Hall electric motor signal, style D, the electro-gas signal, style E, and the Hall normal-danger "wireless" circuit, devised by Mr. Bezer; the Union electric motor signal, style B; the "wireless" polarized relay circuit, and the alternating current circuit for electric railroads; the Pneumatic Signal Company's alternating current circuit for electric railroads and the Miller cab-signal.

Then follow some tables, shown, abridged, herewith. These are dated Sept. 1, 1903.

*Table* 1.
Number of Block Signals in Use.

| No. of roads. | Signals. | Signals— Home. | Distant. | Total. | Miles of continuous blocking— Single track. | Two or more tracks. | Total miles of track. |
|---|---|---|---|---|---|---|---|
| 9 | Electro-pneumatic semaphore | 1,649 | 1,451 | 3,100 | ..... | 282.7 | 917.5 |
| 20 | Electric semaphore ........ | 2,466 | 1,484 | 3,950 | 495.08 | 1,021.81 | 2,654.2 |
| 9 | Electro-gas semaphore ..... | 254 | 236 | 490 | 10.4 | 96.0 | 226.4 |
| 30 | Enclosed disk.............. | 2,894 | 1,418 | 4,312 | 151.48 | 1,192.0 | 2,724.86 |
| 7 | Clockwork disk ............ | 942 | 10 | 452 | 206.81 | 286.25 | 779.31 |
| | Total ................ | 8,205 | 4,599 | 12,804 | 863.77 | 2,878.76 | 7,302.27 |

*Table* 2.
Number of Signal Movements.

| No. of roads. | Signals. | Average per day. 24 hrs. | Total for year. |
|---|---|---|---|
| 7 | Electro-pneumatic sem.. | 101,540 | 37,062,432 |
| 15 | Electric semaphore .... | 89,895 | 32,811,810 |
| 4 | Electro-gas semaphore .. | 6,471 | 2,361,884 |
| 23 | Enclosed disk ........ | 221,131 | 80,712,822 |
| 6 | Clockwork disk ....... | 35,964 | 13,127,255 |
| | Total ............ | 455,001 | 166,076,113 |

*Table 3.—Failures.*
Number of Signal Failures Per Year.

| No. of roads. | Signals. | Failures per yr. | Signal movements— Per year. | Avg. per failure. |
|---|---|---|---|---|
| 4 | Elec.-p. sem.... | 1,459 | 23,561,175 | 16,060 |
| 13 | Electric sem.... | 5,066 | 25,917,614 | 5,116 |
| 4 | Elec.-gas sem... | 135 | 2,361,884 | 17,495 |
| 16 | Enclosed disk .. | 4,446 | 80,220,899 | 18,013 |
| 5 | Clockwork disk. | 3,329 | 13,097,325 | 3,934 |
| | Total ..... | 14,435 | 145,158,897 | 10,056 |

Note.—Roads reporting 20,917,216 signal movements per year, included in Table 2, having kept no record of signal failures, are necessarily omitted from Table 3.

In connection with table No. 3 some of the roads, but not all of them, reported the number of false clear indications. In consequence of the incompleteness of the statement comparison with the non-dangerous failures cannot be made, but we give the figures for what they are worth, as follows: Electro-pneumatic, 4 roads, 35 failures; electric motor, 11 roads, 184 failures; electro-gas, 1 road, 1 failure; enclosed disk, 9 roads, 35 failures; clock work, 2 roads, 13 failures; total failures, 268.

The causes of these failures are given as follows:

FALSE STOP INDICATIONS.

*Electro-pneumatic Semaphore—*

| | |
|---|---|
| Broken air pipe ........................ | 6 |
| Broken wires. .......................... | 45 |
| Frost .................................. | 126 |
| Lightning .............................. | 53 |
| Malicious disturbance .................. | 10 |
| Short circuit .......................... | 32 |
| Storm .................................. | 34 |
| Unclassified or unknown ................ | 37 |
| | 343 |

*Electric Semaphore—*

| | |
|---|---|
| Broken blades .......................... | 4 |
| Broken bond wire ....................... | 146 |
| Broken line wire ....................... | 134 |
| Broken mechanism ....................... | 54 |
| Foreign current, including lighting ......... | 85 |
| Frost .................................. | 9 |
| Malicious disturbance .................. | 87 |
| Storm .................................. | 910 |
| Unclassified or unknown ................ | 651 |
| | 2,080 |

*Electro-Gas Semaphore—*

| | |
|---|---|
| Lightning .............................. | 8 |
| Malicious disturbance .................. | 1 |
| Unclassified or unknown ................ | 85 |
| | 94 |

*Enclosed Disk—*

| | |
|---|---|
| Broken bond wire ....................... | 437 |
| Broken line and other wires ............ | 215 |
| Broken switch instrument ............... | 4 |
| Foreign current, including lightning......... | 124 |
| Malicious disturbance .................. | 128 |
| Short-circuit .......................... | 16 |
| Storm .................................. | 522 |
| Unclassified or unknown ................ | 295 |
| | 1,741 |

*Clockwork Disk—*

| | |
|---|---|
| Broken line wires ...................... | 15 |
| Foreign current, including lightning........ | 130 |
| Heat ................................... | 2 |
| Malicious disturbance .................. | 98 |
| Storm .................................. | 2 |
| Unclassified or unknown ................ | 609 |
| | 856 |

FALSE CLEAR INDICATIONS.

*Electro-pneumatic Semaphore—*

| | |
|---|---|
| Armature stuck ......................... | 1 |
| Circuit-breaker failed ................. | 2 |
| Errors or neglect of batterymen and linemen. | 14 |
| Lightning .............................. | 7 |
| Storms and frost ....................... | 11 |
| | 35 |

*Electric Semaphore—*

| | |
|---|---|
| Broken pawls and pins .................. | 6 |
| Circuits grounded ...................... | 8 |
| Errors or neglect of batterymen and linemen | 31 |
| Frost and storm ........................ | 18 |
| Foreign current ........................ | 4 |
| Malicious disturbance .................. | 3 |
| Unclassified or unknown ................ | 114 |
| | 184 |

*Electro-Gas Semaphore—*

| | |
|---|---|
| Leaky track circuit .................... | 1 |

*Enclosed disk—*

| | |
|---|---|
| Crossed wires .......................... | 5 |
| Foreign current, including lightning......... | 13 |
| Grounded signal current ................ | 2 |
| Red glass broken ....................... | 1 |
| Unclassified or unknown ................ | 14 |
| | 35 |

*Clockwork Disk—*

| | |
|---|---|
| Cross in lightning arrester............. | 1 |
| Lightning. ............................. | 12 |
| | 13 |

*Table. 4.—Failures.*
Number of Signal Failures. Per Year.

| No. of roads. | Signals. | Batteries (broken jars,etc.). | Faulty maintenance—or inspection— Signal Dept. | Roadway Dept. | Miscellaneous. | Total. |
|---|---|---|---|---|---|---|
| 4 | Electro-pneumatic semaphore ........... | 97 | 677 | 342 | 343 | 1,459 |
| 14 | Electric semaphore .................... | 771 | 1,621 | 594 | 2,080 | 5,066 |
| 5 | Electro-gas semaphore. ................ | 11 | 21 | 9 | 94 | 135 |
| 16 | Enclosed disk ......................... | 876 | 1,318 | 511 | 1,741 | 4,446 |
| 5 | Clockwork disk ........................ | 322 | 1,715 | 436 | 856 | 3,329 |
| | Total ......................... | 2,077 | 5,352 | 1,892 | 5,114 | 14,435 |

In table 5, entitled cost, the noticeable feature is the low cost of the electro-pneumatic signal. The interest on the cost of installation is given as lower than that of any other automatic signal. This is somewhat surprising since it is well known that the first cost of the electro-pneumatic signal is higher than that of any other automatic signal. The fact that many of the other signals are in isolated locations and the electro-pneumatic is used only in a continuous system and comparatively short blocks is not enough to account for this discrepancy. Mr. Platt seems to have been struck with this peculiarity in his returns, for he takes occasion to mention that these average costs do not show which is the most economical or most costly signal under specific conditions.

*Table 5.—Cost.*
Average Cost per Signal per Year.

| No of roads. | Signals. | Interest on cost of installation. | Depreciation and renewals. | Inspection and repairs.— Labor. | Material and supplies. | Total. |
|---|---|---|---|---|---|---|
| 2 | Electro-pneumatic semaphore ........ | $22.56 | $21.60 | $35.05 | $40.70 | $119.91 |
| 10 | Electric semaphore ................ | 34.23 | 41.21 | 53.94 | 49.63 | 179.01 |
| 2 | Electro-gas semaphore.............. | 31.99 | 38.43 | 37.23 | 22.90 | 129.55 |
| 14 | Enclosed disk...................... | 27.79 | 26.07 | 35.24 | 31.16 | 120.26 |
| 6 | Clockwork disk .................... | 24.04 | 20.58 | 53.45 | 25.74 | 123.81 |

Mr. Platt expects that by the time the congress assembles in Washington, the number of automatic signals in use in America will be 16,000, and the total number of miles of track protected by such signals approximately 10,000.

Referring to the action taken by the Paris Congress in 1900, he says that the experience of many years has demonstrated that track circuits and the necessary insulations and bonding therefor, are entirely practicable in construction, and have no appreciable effect on the maintenance of the permanent way.

The statistics given above demonstrate the utility and reliability of automatic signals, already covering more than 13,000 signals, protecting more than 7,000 miles of track, by more than 450,000 movements daily. Therefore, he recommends the adoption of the following conclusions:

"1. That automatic signaling, properly designed and installed, be recogized as a suitable means of protection for train and switching movements.

"2. That any automatic signal system, effectually providing that the signals for any block cannot indicate safety before the last vehicle of the train which may have been permitted to enter the block has cleared the same, be approved."

## G. Bouscaren.

Mr. Gustave Bouscaren, one of the ablest civil engineers of this country, died at his home in Cincinnati, Ohio, on Sunday last, at the age of 64. He had been in precarious health for more than a year and had been confined to his home for many months.

Louis Frederic Gustave Bouscaren was born August 25, 1840, at Pointe-a-Pitre, Island of Guadaloupe, French West Indies, of French parentage, his father having been an officer in the service of the first Napoleon. His family removed to the United States during the boyhood of Gustave. He studied in St. Xavier College, Cincinnati, and in Georgetown College, Ky. In 1853 he entered the Lysée St. Louis, Paris, France, graduating in 1859, and afterward took the course in mechanical and civil engineering in the Ecole Centrale des Arts et Manufactures. Returning to the United States he began his professional work, in 1862, as a mechanical and architectural draftsman in Cincinnati. He entered upon his railroad career in 1865 as an assistant engineer on the Ohio & Mississippi. Later he was in charge of construction, successively on the Vandalia, the Cairo & Vincennes, and the St. Louis & Southeastern.

In 1873 he was called to the construction of the Cincinnati Southern as first assistant to the chief engineer, Mr. Thomas D. Lovett, and upon Mr. Lovett's retirement in 1876 he became the chief engineer of that important work, continuing in the position until the completion and opening of the road, and afterward as chief engineer of the operating company, the Cincinnati, New Orleans & Texas Pacific. During this latter period the New Orleans & North Eastern and the Vicksburg, Shreveport & Pacific, were built by interests under the control of the C., N. O. & T. P., with Mr. Bouscaren as chief engineer. Resigning in 1884 he opened an office in Cincinnati for practice as consulting engineer.

Among the notable works of which he had charge after that date were the construction of the Covington (Ky.) water works and the new system of water supply for Cincinnati, of which he was chief engineer from its inception until his death. He also designed and had charge of the reconstruction of the Covington & Cincinnati suspension bridge, originally built by Roebling, and of designs for the Chesapeake & Ohio bridge over the Ohio river at Cincinnati. He served on many engineering commissions and committees of the American Society of Civil Engineers, among which may be named the commission appointed by President Cleveland to report upon the feasibility of and the longest practicable span for a bridge over the North River at New York; and (as chairman) on the committee of the Am. Soc. C. E., to report upon a standard rail section. This memorable report revolutionized and standardized rail sections for American railroads to such an extent that more than three-fourths of all the rails now produced in this country conform to the section recommended by the committee.

About the time of the construction of the Cincinnati Southern the science and art of bridge building made very notable advances, and in these Mr. Bouscaren took a conspicuous part. His specifications for the bridges on that road introduced radical innovations, since very generally adopted, in the design and construction of railroad bridges. It may fairly be said that he was the pioneer in not a few features of modern railroad bridge design, and he did not escape the common penalty of the advanced thinker in every field of human effort, though he had the good fortune to live to see his work vindicated. He introduced the use of train diagrams in figuring live load, and his specifications were the first to require the testing to destruction of full sized compression members. He also introduced many improvements in bridge details. Under his specifications the two most notable bridges of the period were constructed—the Ohio river bridge at Cincinnati with its then unequalled truss channel-span of 519 ft., and the remarkable bridge over the Kentucky river, the first important cantilever bridge built in this country.

At the time of his death Mr. Bouscaren was a vice-president of the American Society of Civil Engineers, and chairman of the special committee of the society to further consider and report upon railroad rail sections. Mr. Bouscaren was peculiarly well equipped intellectually for his profession. His highly cultured mind was vigorous, analytical, persistent and bold; few men had to a greater degree the courage to follow their convictions. His work was broadly planned and worked out with painstaking attention to the minutest details. His conception of engineering work seemed to be that the best was never too good, and that anything which fell short of that high standard was to be tolerated only when conditions made it unavoidable. It followed naturally that he expected and insisted upon a high standard of performance on the part not only of his professional assistants, but of contractors engaged upon work under his supervision. If sometimes considered rather exacting by the latter class, his motives were understood and respected by them, and his conscientious probity and honor were unquestioned. In his personal and social relations he was a Christian gentleman—what more need be said?

His death is a serious loss to the profession which he adorned and honored, and will be felt keenly not only by hosts of warm friends, but by the large number of engineers who as young men, were members of his professional family, and owe not a little of their success to his kindly help and thorough training.

## Railroad Shop Tools.

*(Continued.)*

### UPRIGHT DRILLS.

The drill shown in Fig. 1 is made by W. F. & John Barnes Company, Rockford, Ill. This tool is known as the No. 3 upright drill and it has a 34-in. swing. It is 8 ft. 2 in. high and the distance from the spindle to the base is 57 in. The diameter of the column is 9¼ in. and the spindle is $1^{15}/_{16}$ in. in diameter and has a No. 4 Morse taper hole. The spindle has roller thrust bearings, self-feed, automatic stop, and quick return motion. The maximum distance from the spindle to the table is 39¾ in. The table is 30 in. in diameter and has a vertical hand adjustment which is operated by means of the miter gears and screw shown in the illustration. The sliding head has a vertical adjustment of 29 in. and the spindle has a travel of 16½ in. There are eight changes of positive gear-driven feed ranging from .006 to .064 in. per revolution of the spindle and the back gear ratio is 6 to 1. The weight of the machine is 2,600 lbs. and the floor space required is 76 in. x 26½ in. The countershaft should run at 175 r.p.m.

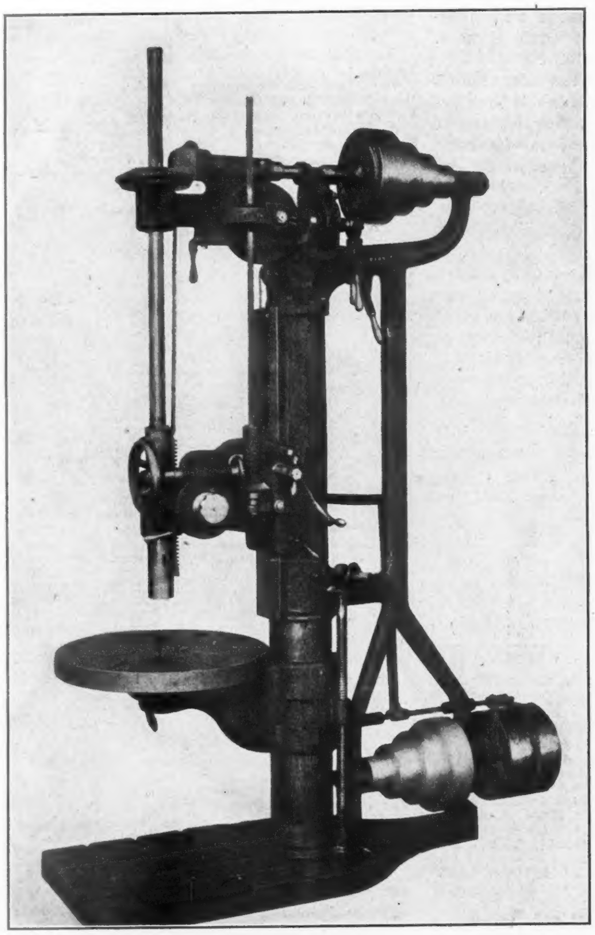


Fig. 1—Upright Drill, W. F. & John Barnes Company.

The illustration, Fig. 2, shows a machine made by A. D. Quint, Hartford, Conn. It is known as the Quint No. 4 turret machine and is designed for boring, drilling, reaming and tapping holes with but one setting of the work. It practically holds the same relation to the common drill press that the turret lathe holds to the common lathe on work that can be rotated. For certain classes of work this drill is better than the multiple spindle drill, for when using the latter, work must be moved, in turn, after each operation from one spindle to another. With the turret drill, the drills, reamers, taps, etc., are placed in their respective spindles, each of which has an independent stop which can be adjusted for different depths of holes. These different tools, as in the turret lathe, can all be brought to the center and in position for use without stopping the machine. All of the tools in the head that are not in use do not rotate and are out of the way and do not interfere with the work. The illustration shows a 4-spindle, 32-in. machine fitted with a reversing tap holder suitable for drilling or tapping up to 2 in. in solid iron. The base, column, stand and table are the usual type used on upright drills. The sliding head on the column is balanced by a weight, and carries the feed mechanism, the locking

device and the steel spur gearing for the transmission of motion from the vertical shaft to the revolving tool spindle. On the sliding head is mounted a rotary turret head. All the spindles in the turret are indexed to the same point when the spindle is in position for work. Any spindle wanted may be swung into position without stopping the machine by means of a lever shown on the front of turret, which when moved to the right will release the index pin. When the turret is revolved to the spindle wanted, the lever will automatically lock the turret head with the spindle running in position for work. The hand feed is operated by a hand-wheel in front of the turret. The power feed is operated by the belt and cone pulleys on the sliding head. The feed is started and stopped by the knock-off in front of the hand wheel, or it can be set to stop automatically for any depth up to 28 in. by means of the stop shown on the face of the column. The quick return of the head is obtained by means of the pilot wheel on the left-hand side of the head. The clutch for connecting the back gears may be thrown in or out while the tool is running. These Quint turret machines are made in four sizes with from four to 12 spindles.

Fig. 3 shows a 40-in. swing, back-geared drill made by the New Haven Manufacturing Company, New Haven, Conn. The spindle of this machine is balanced and has a feed of 12 in. operated either by hand or power, has an automatic stop, a quick return motion and an index for measuring the depth of the hole drilled. The shipper is fitted with a brake for stopping the spindle quickly. The head is adjusted by means of a screw operated by miter gears. The adjustable arm which carries the table can be swung aside so that the base plate can be used for drilling. The back gearing is operated by a lever which is within easy reach of the operator. The spindle is 2½ in. in diameter and is of hammered crucible steel fitted with a solid forged collar, and is reamed to fit a No. 5 Morse taper and will hold drills from $2^1/_{16}$ in. to 3 in. inclusive. The wear between the quill and the spindles is taken care of by a loose, hardened tool steel collar which is cupped to hold oil. The quill has a threaded collar for taking up wear. All gears are cut from solid blanks. The countershaft is at the base of the machine, and the driving shaft and spindles run in cap boxes. The distance from the face of the post to the center of the table is 20 in., the maximum distance from the spindle to the base plate is 53 in., and the greatest distance from the spindle to the table is 34 in. The vertical traverse of the table is 15 in. and the vertical traverse of the adjustable head is 14 in. The planed surface of the base plate measures 35 in. x 32 in., and the diameter of the adjustable table is 36 in. The machine is 9 ft. high and weighs about 4,200 lbs. The driving pulleys are 16 in. in diameter and have a 3¼ in. face. The largest cone pulley is 14 in. in diameter and it takes a 3-in. belt. The countershaft should run at 225 r.p.m. These drills can be arranged for tapping by adding a pair of friction pulleys which are supported in a bracket attached to the rear of the base of the machine. A device for automatically reversing the machine and running back the tap by power is also supplied when desired. (*To be continued.*)

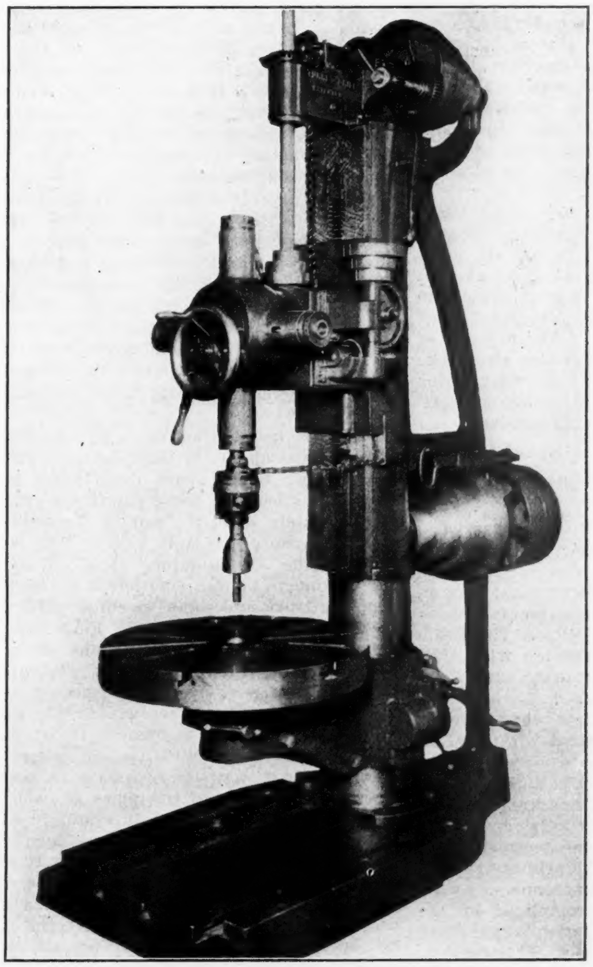


**Fig. 2—The A. D. Quint Upright Turret Machine.**

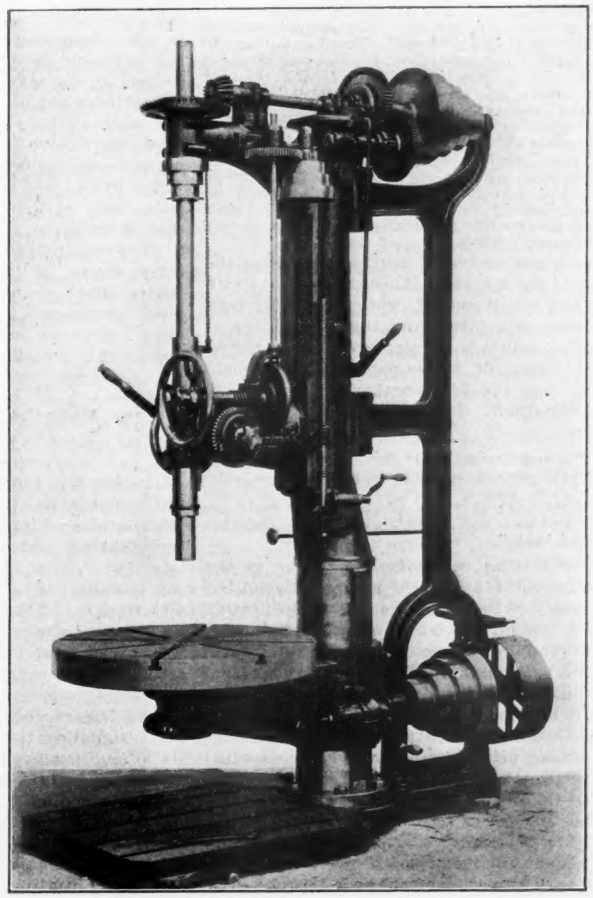


**Fig. 3—Upright Drill, New Haven Manufacturing Company.**

### The Block System in Iowa.

At the meeting of the Iowa Railway Club which was held at Des Doines on September 12, there was an animated discussion on the question whether or not the block system can be used on the railroads of the west and, if it can be used, whether it is worth having. At a previous meeting a paper had been read by Mr. P. G. Campbell, Chief Train Despatcher of the Chicago & North Western, at Boone, speaking favorably of the block system, and at this September meeting Mr. A. T. Woodruff, Examiner on the Chicago Great Western, read a paper sustaining the opposite side of the question; and the subject was discussed by Messrs. Hammill, Shipley and others.

Mr. Woodruff says that the increase in operating expenses resulting from the use of the block system on the average western railroad will amount to about $1,000 a month for each 100 miles; which means, we suppose, that usually it is found necessary to put on about 20 additional operators or signalmen in a road of that length. From this he goes on to argue that unless the cost of collisions is reduced at least $12,000 a year the block system is too expensive. As he has not found any hundred miles in Iowa where the collision losses have amounted to this sum, he is satisfied that the block system is not worth having. He holds that the delays due to block signaling and their cost are a dead loss. He believes that every attempt to work the absolute block system on lines of heavy traffic in the west have failed; permissive blocking had to be substituted. Permissive blocking is dangerous; no railroad man can be made to believe that the rule, to run under control when a permissive signal is given, will be lived up to. The under-control rule

is not made any safer by having the initials of the despatcher on the caution card. Mr. Woodruff went on to detail some of the bad practices which he finds where the block system is ostensibly in use.

An operator is liable to signal a clear block when it is not clear. This may result from the mechanical oversight of a sleepy operator or from a misunderstanding. An incompetent operator misinterprets the telegraphic code. A "get there" operator clears the block when a train is "coming" to release a following train, which may otherwise be seriously delayed for an opposing train. The nervous operator loses his head. A stupid operator don't know why he did it.

A conductor will perhaps occupy the main track at a station doing work, figuring that the operator is protecting him. The operator does not understand it that way and the train is unprotected.

A favorite trick of a certain class of night operators is to find out "what is coming," then change the position of the signal to "proceed" and go to sleep, depending on the first passing train to awaken them.

The custom of using the train order signal for a block signal is a dangerous practice peculiar to the block system. The normal position of the signal is at "Stop." There is nothing to remind the operator that he has orders for a train and nothing to indicate to the engineer that orders are awaiting him. It all depends on the operator's memory, which if defective will result in his failing to deliver the orders.

Another thing which must not be overlooked, responsibility has been removed from train and engine-men, who as a class are men of experience and mature judgment, and increased responsibility imposed upon operators, who as a class are young, frequently inexperienced and sometimes, perhaps, incompetent.

As a preventive of butting collisions the manual block system affords additional security, but Mr. Woodruff, while admitting this, declares that displaying the stop signal at meeting points is simpler and less expensive.

Mr. Campbell, whose paper had been criticized, was the first speaker in response to Mr. Woodruff. He spoke of a recent case where

"A heavy freight train broke an air hose, and hurt the conductor and rear brakeman, and there was nobody there to protect the train until the men at the head end of the train got back and saw the condition of affairs, and they flagged back."

As to butting collisions, the order at the meeting point is all right if there be an order, but many of the collisions are between trains which should meet according to the timetable and rules, no orders being issued. In two years on his (block signaled) division he could recollect no collision of either kind.

Mr. Hammill (C. & N. W.) with ten years' experience as despatcher and trainmaster on a road using the block system combated the claim that the block system caused delays. On one division he had moved 28 stock trains, six passenger trains and three fast freights in one direction and a corresponding movement in the opposite direction, in one day, with an outlay of not over $200 for overtime of freight trainmen, mostly those on way freights. Mr. Hammill cited instances of the block system preventing collisions where operators or despatchers had neglected to give proper meeting orders. If he were general manager of a railroad on which there were but two trains a day, one each way, he would use the absolute block system.

Mr. Campbell, in telling of the practice on the North Western, said that enginemen sometimes objected to running on a caution card at night when patches of fog are liable to arise; and the despatcher never compels an engineman to run on a caution card. Regarding the assertion that enginemen running under a permissive signal do not carefully regulate their speed, he said that the train sheets would show that the claim is not true, as regards his division; trains running under permissive signaling take much more time than those which get clear signals. In his experience, on two divisions, he has never known a train to get into trouble while running under a caution card. It must be acknowledged that the block system permits certain kinds of carelessness, "but all you need to do is to drill the men and discipline them a little stronger, and you will get the desired results." On the Iowa division 10 to 15 caution cards are issued daily; nearly all of them are for way freight trains.

Mr. Schevenell.—Mr. Woodruff has admitted that the manual block system is useful as a precaution against head end collisions; and I want to say that in the last ten years four or five disasters have been averted just in this way. Despatchers issue orders for a train to run extra and overlook an opposing extra; a despatcher seldom discovers an error of that kind until it is too late, while the block system does prevent the collision. This feature alone will pay for the extra expense of the block system. The claim that the block system increases expenses $1,000 a month is excessive. With the light traffic which has been referred to in this discussion it can be installed without one cent of extra expense; though, of course, it is necessary, at some stations where there is no night operator, to lengthen the block sections at night.

On the North Western for three years much double tracking has been done between Belle Plaine and Council Bluffs; 30 to 50 miles west of Boone, and the same amount east of Boone each year. For this work 40 to 65 work trains have been employed from early spring to late fall. There was, of course, much changing of grades also. The block system was in use and the work trains were run under permissive signals, but during all this time there was no accident.

## Storage Batteries for Signal and Track Circuits.

The Electric Storage Battery Company, of Philadelphia, has issued a description of the installations of its chloride accumulators on the Reading and the Pennsylvania roads; nd we give it, condensed, below. The Reading installation is in connection with Hall disk signals and the Pennsylvania with Westinghouse electro-pneumatic.

In the case of interlocking, when there is a considerable current demand within a limited area, storage batteries have already largely superseded primary batteries, but in block signaling the conditions are different. On a four track road, the decision will undoubtedly be in favor of the secondary battery; but on single track the primary battery will frequently show better economy. An installation has just been completed by the Philadelphia & Reading between Wayne Junction and Huntingdon street, Philadelphia, where the concentration of the devices requiring current has made the comparison of the cost of furnishing power by primary cells and by storage batteries greatly in favor of the latter. It is estimated that the cost of the storage battery installation will be returned within the first year's operation. This section consists of four tracks, and is 12,500 ft. long. The primary cells were distributed at eight points, a total of 1,203 cells being used. At each of these points storage battery cells, type PT, have been put in, requiring a total of 134 cells to displace the 1,203 primary cells. This type of cell has a capacity of 24 ampere hours. At each location there are two sets of storage cells, one being used to operate the signals while the other set is being charged. In other words, there are 67 storage cells in service at one time. The number of cells in each set at each battery point varies from a minimum of seven to a maximum of 20, this being necessary on account of the different voltages required. From some of the battery points several circuits of different voltage are desired, and this is accomplished with one battery. Resistance in the form of counter electro-motive-force cells is used to reduce the voltage to the requirements of the minimum voltage circuit.

At a point approximately 3,000 ft. from Wayne Junction is the charging station. Here are installed two direct-connected generating sets, each having a capacity of 275 volts and 10 amperes. Two generators are provided in order that one shall serve in case of a breakdown of the other. From this charging station two charging circuits are run, a No. 12 wire to Wayne Junction, and a No. 10 to Huntingdon street. There is a rheostat which can be inserted in either circuit. Each day one of the batteries at each battery point is thrown upon the charging circuit while the other is left to operate the signals. The batteries on charge at the various battery points on each charging circuit are, therefore, all in series with each other and are cut out one by one as they are filled. The system has been working in the most satisfactory manner, and the labor has been somewhat reduced.

The Pennsylvania Railroad is using storage batteries for signal work on the Philadelphia Division, from Philadelphia to Downingtown; on the Pittsburg Division, from Gallitzin to Wiltmere; on the Monongahela Division, from Pittsburg to Thompson; on the Maryland Division of the Philadelphia, Baltimore & Washington, from Philadelphia to Wilmington; and from Allegheny to Homewood on the Eastern Division of the Fort Wayne.

The first installation made by the Pennsylvania was on the division between Philadelphia and Paoli, about three years ago. The signals between these points are spaced approximately 3,000 ft., and in the base of each semaphore are from two to four cells of "Chloride Accumulator," type 5-E, capacity 80 ampere hours. One cell is discharged upon the track and signal circuits, while the other cells are being charged. Each day an inspector goes over the route and changes the batteries from charge to discharge. While the batteries are thus inspected each day and charged every second day, the cells are of sufficient size to operate the signals for five or six days. With the old system of gravity cells it would be necessary to install about 24 primaries in the place of each of the two storage cells, and it would require five or six times the number of men for handling the batteries. With gravity it was customary to have two distinct batteries, one upon the track circuit and one upon the signal circuit. With the storage battery one cell operates both.

The Southern Pacific Railway has storage batteries which are carried from the signals to the generating station, charged and returned. This road is using a cell of 50 ampere hours capacity, these cells being contained in rubber jars, mounted in wood cases —two cells to each case, with handles so that they can be readily transported. The weight of each of these cells is approximately 12 pounds.

Each of these storage cells replaces eight primary cells. Four of these cells are used to each signal, or to each pair of signals where the signals are near enough together to permit this. Once a month the cells are returned to the charging station, inspected and recharged. The cells are charged in sets of seven, four to each set, making 28 cells in all. These charged batteries are then returned and exchanged for others which have been in use for one month.

Many of the principal railroads of the country use chloride accumulators in signal service.

# GENERAL NEWS SECTION

### THE SCRAP HEAP.

The telegraph block system has been put in use on the Cleveland & Pittsburg between Cleveland, Ohio, and Alliance, 57 miles.

The Railway Commission of Canada has ordered an examination of the St. Clair tunnel with a view to making a report on the conditions which led to the recent death of six men in the tunnel by suffocation; and some of the newspapers of Port Huron, Mich., are calling upon the United States Government to take similar action.

The quantity of grapes sent to market annually from Chautauqua County, New York, is 90,000 tons. This statement is made by Mr. A. M. Loomis, of Dunkirk, the editor of the *Grape Belt*, who has charge of the exhibit from his county shown at the World's Fair, where 1,229 plates of grapes are displayed in the Horticultural Building. Mr. Loomis says that the total area of vineyards in the State of New York is 60,000 acres, of which one-half is in Chautauqua County. He estimates the shipments from that region at 8,000 car loads annually, and those from Central New York at 6,000 or 7,000 car loads.

### Large Contract for the Canadian Westinghouse Company.

The Canadian Westinghouse Company has made a contract to supply the air-brake equipment for all cars that may be required by the new Grand Trunk Pacific Railroad. As the number is estimated as between 20,000 and 50,000, it will take 50 per cent. of the entire output of the air-brake department of the Canadian Westinghouse Company four years to supply the contract.

### New Naval Ships.

Secretary Morton has approved the recommendation of the Naval Board on Construction for the general features of the three new scout ships, Chester, Birmingham and Salem, for which bids will be opened early in the year. The ships will be: Four hundred and twenty-four ft. long; 48 ft. 8 in. beam; draft at full load, 18 ft. 3 in.; displacement, 4,310 tons; speed, 24 knots; battery, twelve 3-in. guns and two submerged torpedo tubes.

### "The Acme of Perfection."

Not every railroad manager has fallen so low that he can afford only mourning paint for his engines, as witness the following from a Georgia paper:

WAYCROSS, Oct. 29.—Beginning this morning, the Atlantic & Birmingham railroad will use for its passenger trains locomotives painted red, and their first appearance created unusual interest. The tender, with gold lettering and red background, presents a most pleasing view. Now the entire train matches, the engine and coaches all being the same color. With red engines, electric lighted and steam-heated coaches, the Atlantic & Birmingham's passenger service is very near the acme of perfection.

### The Victor Stoker Company.

A company by this name was formed last week in Ohio, with a capital of $200,000, to take over the patents and business of the Day-Kincaid Stoker Company, of Cincinnati, maker of automatic stokers for locomotives and steamers. The stockholders include S. F. Dana, William C. Herrin, M. E. Ingalls, L. A. Ault, Frank B. Wiborg, D. T. Williams, H. M. Levy, Arthur Stem, D. A. Wallingford, Jr., J. H. Day, C. A. Kincaid, J. W. Kincaid, E. P. Harrison, Arthur Espy, L. F. Walters, J. C. McCarty, George F. Dana, D. V. Sutphin and George Hoadley. The company has taken options on ten acres of land and expects to build shops in the spring. Press reports state that the American Stoker Company, of Erie, Pa., will probably be consolidated with the new concern.

### Passenger Elevators on Trans-Atlantic Steamers.

The two new ocean steamers now being built at Stettin for the Hamburg-American Line will have passenger elevators to take passengers or members of the crew to any of the five decks of the steamers. There will be restaurants so that passengers may eat at any hour, and each steamer will be equipped with a Turkish bath room and a large gymnasium. In the first cabin staterooms, there will be no upper berths. Some of the rooms will be 10 ft. x 17 ft. The steamers, to be called the Kaiserin Auguste Victoria and the America, are being built at the Vulcan Works. The former is 705 ft. long, 77 ft. beam and 53 ft. 9 in. deep. She will have a cargo capacity of 16,000 tons, and carry 600 first-cabin, 300 second-cabin, 250 third class and 2,139 steerage passengers. There will be three promenade decks.

### The Sherwin-Williams Co.

All the managers and traveling representatives of the Sherwin-Williams Co., the well-known paint and varnish makers, met for their 24th annual convention at Chicago last week. All former conventions have been held at Cleveland, but the participants seem to feel equally well at home in Chicago. These conventions are not holidays but conferences to study seriously trade conditions and to devise plans for expansion. Daily sessions are held morning and afternoon. During the last 12 months the company's business has steadily increased and the year just closed was by far the largest in its history. A new paint plant was completed at Montreal, which is the largest of its kind in Canada; new general offices were completed at Cleveland; another factory was erected at Chicago; the warehouse capacity at Newark was increased; large extensions are now being made to the Linseed Oil Mill at Cleveland; a new distributing point has just been opened at Portland, Oregon, and others are to be established at Cincinnati, and at Savannah; and 36 new representatives have been added to the selling staff. This is a fine record for a year which some business concerns have found dull. On Wednesday there was an automobile excursion around the city, and a dinner at the Auditorium Hotel in the evening.

### Westinghouse Companies' Awards at the World's Fair.

The several Westinghouse Companies having exhibits at the Louisiana Purchase Exposition, St. Louis, have received in all one special award, 12 grand prizes, eight gold medals, four silver medals and one bronze medal. The special award given to all of the allied companies was for the "best, most complete and most attractive installation in the Department of Machinery." The Westinghouse Electric & Manufacturing Co. received three grand prizes, three gold medals and one silver medal; Westinghouse Machine Company, one grand prize; Westinghouse Air-Brake Company, one grand prize and one gold medal; Westinghouse Traction Brake Company, one grand prize; Westinghouse Automatic Air & Steam Coupler Company, one grand prize; Westinghouse Brake Company, Limited, of London, one grand prize; Westinghouse Company, Limited, of St. Petersburg, one grand prize; Union Switch & Signal Company, one grand prize; American Brake Company, one grand prize; Cooper Hewitt Electric Company, one grand prize and one gold medal; Nernst Lamp Company, one gold medal; Pittsburg Meter Company, one gold medal; Sawyer-Mann Electric Company, one silver medal; Bryant Electric Company, one silver medal; Societe Anonyme Westinghouse, of Havre, France, one silver medal, and the Perkins Electric Switch Manufacturing Company, one bronze medal.

### Free Rides for a Whole State.

Not the least exciting feature of the political campaign just closed was the contest in South Dakota over the proposition to change the State capital from Pierre to Mitchell. According to the New York *Sun* the contest waxed so fierce that Pierre raised $25,000 to advertise its advantages and to influence voters, while Mitchell contributed a sum equally large, if not larger; and as Pierre is on the Chicago & North Western, while Mitchell is on the Chicago, Milwaukee & St. Paul, these two companies entered vigorously into the contest. Besides running scores of special trains, without money and without price, they are said to have spent $25,000 apiece in money. Each railroad not only gave a free ride to and from its favorite city, to any voter who applied, but put forth the best efforts of its advertising department in addition, to make the journey pleasant and attractive. In the rival cities committees were appointed to show visitors around in carriages, and "music by the band" has been an every-day feature. Evidently a colony of the most accomplished scalpers must have been imported from St. Louis for we read that at a place near Pierre, where the Milwaukee crosses the North Western, "agents" of the Milwaukee entered the trains of the North Western and unceremoniously hustled the passengers out of the cars and into waiting Milwaukee trains. It is said that as many as 180,000 people have been taken to the two cities; which makes a fine story, even if one feels it necessary to take off a cipher or two.

### Tests of Rail Auto-Cars.

The official organ of the Austrian Local Railroad Union gives the results of two test runs with a rail auto-car built by Ganz & Company, Budapest. The car is the two steering axle type, with two 50 h.p. motors transmitting the power by means of geared wheels to the center of the two axles, the motor being suspended from the car frame. Two small boilers are on the forward platform cab. A three-ton water reservoir is built into the center of the car frame between the longitudinal sills, and a coal bunker of about 700 lbs. capacity is at the end partition of the motorman's cab. The water and coal capacity is sufficient for a 93 miles run. The car is equipped with a highly geared brake and a Boecker air-brake having an automatic air compressor driven by the car axle. Both brakes operate eight brake-shoes, two for each wheel. The car is lighted with acetylene furnished by a gen-

erator suspended from the car frame. The car contains seats for 38 passengers and is divided into two compartments and a toilet and baggage room from which the conductor can communicate with the motorman.

On September 9 this car was run in the presence of the Austrian Minister of Railways and his staff on one of the Vienna suburban lines and on the following day the car was run on the Vienna Budapest main line from Vienna to Marchegg at a speed of 50.8 miles an hour. On both runs the easy riding of the car was notable and during the principal test runs the consumption of coke was about 4.8 lbs., and the water evaporation about 41 lbs. per kilometer, with which consumption a speed of from 85 to 92 kilometers, equal to 52.7 to 57 miles per hour, was steadily maintained on a level line.

### An Unusual Suit of an Agent.

A question of interest to both manufacturer and agent was recently decided in Kings County in the Supreme Court of the State of New York. The plaintiff, who was formerly exclusive agent in the Metropolitan District, on a commission basis, for a large engineering and manufacturing company, claimed that his employers had shown negligence, incompetence, and lack of engineering skill in manufacturing and installing the apparatus and equipment which he sold for them, to such a uniform extent as to amount to a breach of their contract with him.

It is not questioned that an agent on commission owes a duty to his employer to discharge the duties of his agency with skill and diligence, and that he represent himself as having the necessary skill to properly discharge the duties of the employment he enters. But whether the converse of this proposition be true and whether the employer assumes a reciprocal obligation, has never until now been squarely passed upon by any New York court. The Supreme Court now holds that the law reads into a contract of employment of a sales agent on commission, of machinery to be manufactured and installed, a promise to the agent on the part of the manufacturer to manufacture and install the goods with reasonable skill, diligence and despatch.

A manufacturer has always, of course, been liable to the customers, brought him by his sales agents, to fulfil his contracts with his customers with reasonable skill and diligence, but the obligation to the customer is not available to the agent. It was in his own behalf as an agent that the plaintiff's suit was brought, upon his contention that an implied obligation existed in his favor on the part of the manufacturer to manufacture and install the plants with reasonable skill and despatch. In sustaining the plaintiff's motion, the court in charging the jury said:

"Ordinarily speaking, a man has a right to conduct his business in any manner that he sees fit. His servant or his employee has no right to call him in question; but, that is not always so, and in this case it is not so; because the plaintiff had a duty that he owed to the defendant to faithfully carry out this agreement, to faithfully attempt to sell the defendant's plants in this Metropolitan District—to use his time and his energies in that direction—they had the right to expect that of him. He also had a right to expect of them a faithful performance of their contract, not only in its letter, but in its spirit as well. When he took an order for one of these plants he was entitled to expect that they would use all reasonable diligence and skill in attempting its execution. They owed to him that duty.

The jury rendered a verdict for the plaintiff and judgment was entered in his favor.

### Manufacturing and Business.

E. W. Rosenberg, Secretary of the Handy Car Equipment Company, Chicago, has resigned his position with that company.

Scarritt car seats and chairs, made by the Scarritt Car Seat Works, St. Louis, Mo., were awarded a gold medal at the Louisiana Purchase Exposition.

The F. K. Wilkins Co., of Camden, has been incorporated in New Jersey with a capital of $50,000 to make electrical machinery, by F. R. Wilkins, M. C. Brenneman and N. B. T. Roney.

The Department of Public Communications of Mexico is considering plans made by Engineer Natividad Gonzalez for harbor improvements at Guaymas, estimated to cost about $5,000,000.

The Standard Pulley Manufacturing Co., of New York, has been incorporated with a capital of $100,000. The directors are: Reginald Hawley, M. Lochman and L. S. Lochman, all of New York.

The General Castings Co. has bought land and given contracts for a steel casting plant and the necessary machinery to be located at Verona, Pa. I. H. D. Eagan and D. C. Eagan, Jr., of Philadelphia, are interested.

John Magarvey, Assistant Superintendent of the Brooks Works of the American Locomotive Co. at Dunkirk, N. Y., has been promoted to be Superintendent, to fill the vacancy caused by the death of R. H. Gilmour.

The Exeter Machine Works, of Pittston, Pa., is reported in the market for a 300 k.w. generator for power purposes and a 75 k.w. generator for lighting purposes, together with a 1,000 h.p. water tube boiler and accessories.

At the Louisiana Purchase Exposition the C. W. Hunt Company, West Brighton, New York, received a gold medal for its narrow gage industrial railroad. The company also received the highest award (a silver medal) for its electric storage locomotive.

The Chicago Pneumatic Tool Company, Chicago, has received two gold medals, the highest awards, for its exhibit at the Louisiana Purchase Exposition. This company has a uniform record for the highest awards at all expositions at which it has exhibited, beginning with the Cotton States Exposition at Atlanta, in 1895.

The Light Inspection Car Company, of Hagerstown, Ind., has word from its Shanghai agent that the Japanese government has had two of its cars in use during the war and has found them extremely useful; and the agents of the Japanese government at New York are to order a large number of the cars for immediate delivery.

Sealed bids for building section 2 of the Washington street tunnel, Boston, from near the southerly side of Eliot and Kneeland streets to near the northerly side of Boylston street will be received by the Boston Transit Commission, 15 Beacon street, Boston, Mass., until noon of November 17. B. Leighton Beal is Secretary of the commission. (See advertising columns.)

Robert E. Jennings has been dismissed as receiver of the Carpenter Steel Co., of Reading, Pa., and a new company, mention of which was made in these columns last week, has been formed with a capital of $1,200,000 to make steel and other metals. The incorporators are: W. B. Kunhardt, of Bernardsville; Robert E. Jennings, Jersey City, and Frederick J. Faulks, of Elizabeth, N. J.

The Virginia Bridge & Iron Co., Roanoke, Va., has bought the shops of the Carolina Steel Bridge & Construction Company, of Burlington, N. C., and will henceforth carry on both its own plant and that at Burlington. The combined capacities of the two will be 20,000 tons of finished material yearly. The principal owners of the Carolina company will be interested in the Virginia company.

The seven Crocker-Wheeler generators used at St. Louis to furnish power for the cars of the intramural railroad in the World's Fair grounds will be for sale after January 1. These generators are described in Bulletin 470 issued by the Crocker-Wheeler Company. The electric light and power plant put into the new battleship Connecticut by this company consists of eight generators of 800 k.w. capacity, direct-connected to Forbes engines.

The Delaware, Lackawanna & Western has abandoned its ferry terminal at West Fourteenth street on the North river, New York, and its boats that have been running to that point from Fourteenth street, Hoboken, will in future run to West Twenty-third street, where the company is soon to build a new terminal. The company expects, next spring, to add four large steel screw double-deck ferry boats to its present fleet to be used in the service between the Hoboken station and West Twenty-third street.

The 122 motor car equipments for use on the Long Island Railroad, mentioned in these columns last week, page 507, will be of the latest Westinghouse type, the motors being 200 h.p. each with a liberal overload capacity. The Westinghouse multiple unit control will be used, and the Westinghouse company has supplied this apparatus for 61 trailers also. The machinery for the Long Island power plant is now being installed by the Westinghouse Company. It includes three turbo-generators of 5,500 k.w. each.

On Wednesday, Nov. 2, the members of the Iron and Steel Institute were entertained by the Westinghouse Electric & Manufacturing Company at its works at East Pittsburg, and in the evening a banquet was given in the largest aisle of the shops, its length being one-third of a mile. The portion of the aisle set apart for the banquet was beautifully decorated by flags, and Bremer lamps were strung from the ceiling, while Cooper-Hewitt lamps were suspended from the sides, the latter to make possible the taking of photographs. The souvenir given to each person present was in the form of an induction motor small enough to be carried in the pocket. About 600 persons were present.

### Iron and Steel.

The Mexican Central is reported in the market for 35,000 tons of rails for 1905 delivery.

The Alley Elevated, of Chicago, according to reports, has given a contract for 15,000 tons of structural steel to the American Bridge Co.

The demand for steel plate is increasing in consequence of large orders for shipbuilding on the Great Lakes, and for railroad equipment.

The Lackawanna Iron & Steel Co., reports say, has given a contract to the Bessemer Furnacemen's Association for about 30,000 tons of pig iron.

The Chicago, Burlington & Quincy, it is reported, has given an order to the Carnegie Steel Co., aggregating about $7,000,000 for rails and bridge material.

The Fort Worth Iron & Steel Co., of Fort Worth, Texas, has been given a site on which the buildings for its new works will soon be put up. Its plant at Alliance, Ohio, will be moved to this place. The officers of the company are: W. K. Fogg, President; F. G. Mc-

Peak, Vice-President; J. T. Anderson, Secretary, and W. H. Edleman, Treasurer.

The Republic Iron & Steel Co., of Chicago, working large rolling mills in East St. Louis, has filed a mortgage for $10,000,000 in the County Court at Belleville, covering all the properties of the company at that place, and in Alabama, Illinois and Ohio. This is to provide the necessary funds to wipe out the floating debt, estimated at $2,000,000, and for improvements. The company is building a large rail mill in Youngstown, Ohio, and intends to put new and improved machinery in its other works, making the total cost of the improvements between $2,000,000 and $3,000,000.

## MEETINGS AND ANNOUNCEMENTS.

*(For dates of conventions and regular meetings of railroad conventions and engineering societies see advertising page 24.)*

### New England Railroad Club.

The next regular meeting of this club, which was to have been held November 8, has been postponed until November 15.

### Central Railway Club.

At the regular meeting November 11 at the Hotel Iroquois, Buffalo, final action will be taken on the revision of the constitution, and a report will be discussed by S. T. Dickinson on "The Use of Soda Ash in Locomotive Tanks." A paper will also be read by W. R. Heath, of Buffalo, on "Office Organization."

### Western Railway Club.

The November meeting will be held in the Auditorium Hotel, Chicago, Tuesday, the 15th, at 2 p.m. There will be papers on "Visual Requirements of Railroad Employees," by Dr. Black, of Milwaukee, and on "The Baldwin Four-Cylinder Balanced Compound Locomotive: Results Obtained in Service," by Lawford H. Fry, of the Baldwin Locomotive Works.

## PERSONAL.

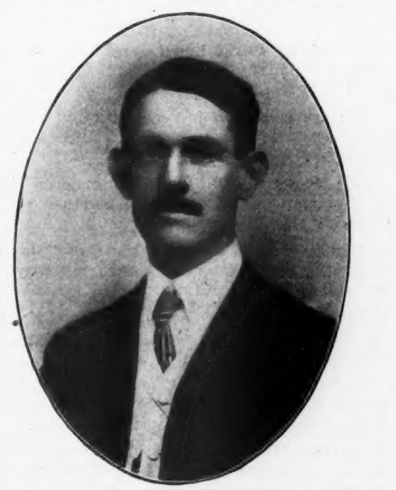
—Mr. Charles Brunson Seger, Auditor of the Pacific System of the Southern Pacific, at San Francisco, was until recently Auditor of the Galveston, Harrisburg & San Antonio. Mr. Seger was born at New Orleans, La., in 1867. He began as an office boy for the Morgan's Louisiana & Texas Railroad & Steamship Company, and has since been in the service of that system as follows: In 1887 he was in charge of steamship accounts with the title of Steamship Auditor; then he was traveling auditor, chief clerk to the General Auditor, Auditor and Secretary of the Galveston, Harrisburg & San Antonio, and the Texas & New Orleans. In January, 1900, his jurisdiction was extended over the Galveston, Harrisburg & Northern.

—Mr. F. M. Gilbert, the new Mechanical Engineer of the New York Central & Hudson River at New York city, is a graduate of the University of Illinois, class of 1887. Previous to that he had served an apprenticeship and worked two years as a journeyman machinist. In 1888 he was connected with the testing department of the New York, Lake Erie & Western, but two years later resigned and went to the Baltimore & Ohio, where in 1892 he became General Foreman of the car and locomotive department at Chicago. In 1897 Mr. Gilbert was engaged in electrical work, and two years later entered the service of the Northern Pacific as Engineer of Tests. For the past five years he has been a draftsman on the New York Central, from which position he is now promoted as above.

—Mr. R. V. Miller, who succeeds Mr. Burr as Superintendent of the Southwestern Division of the St. Louis & San Francisco at Sapulpa, Ind. T., began his railroad career in a freight house when he was about 16 years old. After working for several years in station and yard service, Mr. Miller was, in 1897, appointed Trainmaster of the Kansas City, Fort Scott & Memphis at Fort Scott, Kan. In 1901 he was made Superintendent

of Terminals at Kansas City, and in July, two years later, he became Acting Superintendent of the Northern Division at Fort Scott. In December, five months later, he was promoted to be Assistant to the Second Vice-President at St. Louis. He then went to Cape Girardeau as Superintendent of the St. Louis, Memphis & Southeastern, which is now a part of the Frisco, and a few weeks ago was transferred to the Southwestern Division as above.

—Mr. John V. Hanna, Assistant Engineer of Maintenance of Way of the St. Louis & San Francisco, was born in Plattsmouth, Neb., 40 years ago, and is a graduate of Sheffield Scientific School. Mr. Hanna entered railroad service as a rodman on construction for the Chicago, Burlington & Northern. In 1886 he went to Colorado as Assistant Engineer in charge of canon work, and in the



following spring was put in charge of 18 miles of construction on the Current river. In 1899 he was appointed Resident Engineer on the Kansas City, Ft. Scott & Memphis, and two years later was promoted to be Assistant Chief Engineer. Upon the consolidation of this company with the Frisco, Mr. Hanna was made Assistant Chief Engineer, and upon the reorganization of the maintenance department his title was changed to Principal Assistant Engineer, which position he held until his new appointment as Assistant Engineer of Maintenance of Way at St. Louis.

—Mr. Frederick F. Gaines, the new Mechanical Engineer of the Philadelphia & Reading and the Atlantic City Railroad, was born at Hawley, Pa., in 1871, and was educated at Cornell University. For about one year he was in the shops of the Erie & Wyoming Valley, and in August, 1895, went to the Lehigh Valley as draftsman. The next year (1896) he was appointed Engineer of Tests, and in April, 1897, was promoted to be Mechanical Engineer. Mr. Gaines was later made Master Mechanic at Wilkesbarre, Pa., from which position he resigned only a few weeks ago.

—Mr. E. S. Benson, who has succeeded Mr. Seger as Auditor of the Galveston, Harrisburg & San Antonio, was for three years, from 1871, a clerk on the Chicago, Burlington & Quincy. For six years (1874-1880) he was chief clerk in the accounting department of the Chicago & Paducah, and subsequently worked on the Wabash, the Indiana, Illinois & Iowa, and the Iowa Central. For the past 10 years Mr. Benson has been Auditor of the Oregon Railroad & Navigation Company.

—Mr. James H. Barrett, General Superintendent of the Buffalo, Rochester & Pittsburg, died at his home in Rochester, N. Y., on Nov. 8, at the age of 57. Mr. Barrett was a native of Ireland and began his railroad career in 1861 as a telegraph operator and agent on the Pittsburg, Fort Wayne & Chicago. He served as agent, train despatcher and Assistant Superintendent on the Atlantic & Great Western; Master of Transportation and Division Superintendent on the Pittsburg, Cincinnati & St. Louis; Superintendent of the Cincinnati, Hamilton & Dayton and of the Dayton & Michigan; and 1882-1886, Superintendent of the Dayton & Union. In 1886 he was made superintendent of the Eastern Division of the New York, Lake Erie & Western; in 1888, Superintendent of Transportation, and in 1891, General Superintendent. In 1892 he left and subsequently held similar positions on the Buffalo, Rochester & Pittsburg; Cleveland, Akron & Columbus, and the Southern Railway; and in 1901 was appointed General Superintendent of the Chicago & Alton. In 1903 he left the Alton and since that time had been on the B., R. & P.

—Mr. Riley Williams, who has been appointed Terminal and Lighterage Agent of the Delaware, Lackawanna & Western at New York, in charge of piers, agencies, loading facilities and floating equipment, began his railroad service in 1887 as a locomotive fireman on the Missouri, Iowa & Nebraska, which shortly afterwards was absorbed by the Wabash. Mr. Williams served this company successively as fireman, brakeman, conductor and general yardmaster until 1889, when he resigned to go to the East Tennessee, Virginia & Georgia. Two years later he was appointed Trainmaster for the Des Moines Union and remained with that company for four years. In 1897 he was appointed Superintendent of Terminals of the Grand Trunk at Chicago, and about eight months later went to Battle Creek, Mich., as Trainmaster. In 1900, Mr. Williams resigned to become General Superintendent, at Kankakee, of the Illinois, Indiana & Iowa. Later he went to the Lackawanna as general yardmaster at Buffalo, and in Janury, 1902, was appointed Trainmaster, then Superintendent of the Bangor & Portland Division, and in October last was chosen to be Terminal & Lighterage Agent at New York City.

## ELECTIONS AND APPOINTMENTS.

*Ashland & Western.*—The officers of this company are: President, Calcary Morris; Vice-President, M. J. Mandelbaum; Secretary and Treasurer, A. R. Horr, and General Manager, A. S. Miller.

*Boston & Albany.*—J. A. McRae has been appointed Mechanical Engineer, with headquarters at Boston, Mass.

*Chicago, Cincinnati & Louisville.*—See Cincinnati, Hamilton & Dayton.

*Chicago, Rock Island & Pacific.*—R. A. Jackson, hitherto General Attorney, has been appointed First Vice-President, succeeding Robert Mather.

*Cincinnati, Hamilton & Dayton.*—The jurisdiction of C. H. Cory, Superintendent of Motive Power, has been extended over the Chicago, Cincinnati & Louisville.

*Gulf, Colorado & Santa Fe.*—M. F. Temple has been appointed Resident Engineer in charge of; construction R. A. Rutledge has been appointed Resident Engineer of the Beaumont Division, at Beaumont, succeeding Mr. Temple, and M. T. Pratt has been appointed Acting Resident Engineer of the Southern Division, at Temple, succeeding J. C. Christy, resigned.

*Jonesboro, Lake City & Eastern.*—F. N. Boyer has been appointed General Freight and Passenger Agent, with headquarters at Jonesboro, Ark., succeeding F. C. Bryant, resigned.

*Lake Shore & Michigan Southern.*—See Toledo, St. Louis & Western.

*Macon, Dublin & Savannah.*—T. K. Scott, General Manager of the Georgia R. R., has been elected President of the M., D. & S.

*Newton & Northwestern.*—L. L. Collier has been appointed Master Mechanic, with headquarters at Boone, Ia.

*New York Central & Hudson River.*—F. M. Gilbert has been appointed Mechanical Engineer, with headquarters at New York City. (See Boston & Albany.)

*Norfolk & Western.*—F. H. LaBaume has been appointed Agricultural and Industrial Agent, succeeding Paul Scherer, resigned. The office of Assistant Agricultural and Industrial Agent has been abolished.

*Pere Marquette.*—J. S. Pyeatt has been appointed Superintendent of Telegraph, with office at Detroit, Mich., succeeding George F. Weidman, resigned.

S. O. Brooks, General Freight Agent, headquarters at Chicago, and C. R. Berry, Assistant General Freight Agent at the same city, having resigned, those offices have been abolished, and all communications are now to be addressed to the General Traffic Manager, A. Patriarche, at Detroit, Mich.

*Philadelphia & Reading.*—D. H. Deeter has been appointed Master Mechanic of the Reading Locomotive Shops, succeeding R. Atkinson, resigned, and H. S. Hunter in turn succeeds Mr. Deeter as Master Mechanic of the New York and Philadelphia Divisions (with the exception of Port Richmond shops).

*Toledo, St. Louis & Western.*—Peter Maher, hitherto Assistant Master Mechanic of the Lake Shore & Michigan Southern, at Elkhart, has been appointed Superintendent of Motive Power and Equipment of the T., St. L. & W.

*Vera Cruz.*—J. M. Nixon has been appointed General Manager, with headquarters at Vera Cruz, Mex., succeeding C. H. Beeston.

*Vera Cruz & Pacific.*—F. C. Gerry has been appointed Superintendent of Transportation, with headquarters at Tierra Blanca, Mex., succeeding T. E. Birbeck.

*Wheeling & Lake Erie.*—J. E. Taussig having been granted a leave of absence, H. W. McMaster will act as Superintendent and Superintendent of Telegraph of the W. & L. E., and as Superintendent of the Wabash-Pittsburg Terminal.

## LOCOMOTIVE BUILDING.

*The Chesapeake & Ohio* has ordered 12 freight locomotives and six switching engines from the American Locomotive Co. All of these locomotives will be built at the Richmond Works.

*The New York, New Haven & Hartford*, as reported in our issue of October 28, is having 20 10-wheel (4-6-0) locomotives built at the Baldwin Locomotive Works. These locomotives will weigh 154,000 lbs., with 110,000 lbs. on drivers; cylinders, 21 in. x 26 in.; diameter of drivers, 72 in.; radial stay extended wagon-top boiler, with a working steam pressure of 200 lbs.; heating surface, 2,691 sq. ft.; 320 tubes 2 in. in diameter and 15 ft. 1 in. long; fire-box, 120.3 in. long and 41¼ in. wide; grate area, 34.5 sq. ft.; tank capacity, 6,000 gallons of water, and coal capacity, 12 tons.

*The Central Railroad of New Jersey*, as reported in our issue of September 23, is having 10 simple 6-wheel switching (0-6-0) locomotives built at the Baldwin Locomotive Works. These locomotives will weigh 124,000 lbs.; cylinders, 18 in. x 24 in.; diameter of drivers, 51 in.; wagon-top boiler, with a working steam pressure of 180 lbs.; heating surface, 1,321.2 sq. ft.; 197 charcoal iron tubes 2 in. in diameter and 11 ft. 7⅛ in. long; fire-box, 109 in. long and 91 in. wide; grate area, 67.75 sq. ft.; tank capacity, 4,000 gallons of water, and coal capacity, 8 tons. Special equipment includes: Westinghouse air-brakes, Sansom bell ringers, sectional Magnesia boiler lagging, Diamond "S" brake-shoes, Tower couplers, Hancock injectors, Magnus Metal Co.'s journal bearings, U. S. piston rod and valve rod packings, Consolidated safety valves, Leach sanding devices, Nathan sight-feed lubricators, Ashcroft steam gages, Standard Steel Works springs and cast-steel centers.

## CAR BUILDING.

*The Hocking Valley* has ordered 100 flat cars from the Pressed Steel Car Co.

*The Southern Indiana* has ordered six passenger coaches from Barney & Smith.

*The United Coal Company* is having 500 freights built by the Standard Steel Car Co.

*The El Paso & Southwestern* has ordered 35 dump cars from the Pressed Steel Car Co.

*The Grand Trunk* has ordered 10 passenger coaches from the Western Steel Car & Foundry Co.

*The Intercolonial* is receiving 100 Ralston dump cars ordered from the Ralston Car Company.

*The Deepwater Railroad* has ordered three combination cars from the American Car & Foundry Co.

*The Interstate Refrigerator Car Company* is having 300 refrigerator cars built by the Standard Steel Car Co.

*The Southern Railway* has ordered six postal cars and three newspaper cars from the American Car & Foundry Co.

*The Chicago, Rock Island & Pacific*, as reported in our issue of Nov. 4, has ordered three postal cars from the Pullman Co.

*The San Pedro, Los Angeles & Salt Lake*, according to press reports, is figuring on the purchase of 2,000 box, stock and coal cars.

*The Philadelphia & Reading* is in the market for 65 passenger coaches. An officer denies that the company intends to purchase new freight equipment at the present time.

*The St. Louis & San Francisco* has ordered 800 box, 400 furniture and 1,000 coal cars from the American Car & Foundry Co. Seven hundred of the 1,000 coal cars are for the Chicago & Eastern Illinois.

*The Lehigh Valley* has ordered 1,000 steel underframe box cars of 80,000 lbs. capacity from the American Car & Foundry Co. for December, 1904, delivery. The company is also in the market for 50 low-side gondola cars of 100,000 lbs. capacity.

*The Illinois Central*, as reported in our issue of November 4, has ordered 500 steel underframe box cars of 80,000 lbs. capacity from the American Car & Foundry Co. The cars will be 36 ft. long, 8 ft. 6 in. wide and 8 ft. high, all inside measurement. Special equipment includes Hewitt Manufacturing Co.'s brasses.

*The Coeur d'Alene & Spokane* expects to purchase three car trains for electric service. The equipment will consist of two combination baggage and passenger motor cars and four trailers. The cars will weigh about 60,000 lbs. and will be 52 ft. long. Special equipment includes: Westinghouse combined automatic and straight air-brakes, M. C. B. standard trucks and steel tired wheels.

*The Wheeling & Lake Erie*, as reported in our issue of October 21, has ordered 1,000 gondola cars of 80,000 lbs. capacity from the American Car & Foundry Co. These cars will weigh 35,000 lbs., and will be 36 ft. long, 8 ft. 6½ in. wide and 4 ft. 4¾ in. high, all inside measurement, with wooden frames and underframes. Special equipment includes: Chicago Railway Equipment Co.'s brake-beams, M. C. B. brake-shoes, Westinghouse brakes, National-Fulton Brass Manufacturing Co.'s brasses, Climax cast-steel couplers, Gould twin-spring draft rigging, Harrison dust guards, McCord journal boxes, Duplex journal box lids, Railway Steel-Spring Co.'s springs, Commonwealth Steel Co.'s bolsters for car bodies and Simplex Railway Appliance Co.'s bolsters for trucks.

## BRIDGE BUILDING.

BERWICK, PA.—The Delaware, Lackawanna & Western, reports say, will give $10,000 towards the cost of the proposed overhead bridge at the foot of Market street. This action insures the building of the Berwick bridge.

BINGHAMTON, N. Y.—Bids are wanted November 21 by D. C. Herrick, City Clerk, for repairs to the Tompkins street bridge.

BUFFALO, N. Y.—A third set of bids may be asked for building the Ohio street bridge over the Buffalo river, the Scherzer Rolling Lift Bridge Co., of Chicago, it is reported, having offered to build a bridge for $100,000. The lowest bid recently opened was that of the Pittsburg Steel Construction Co. for $117,000.

CANAJOHARIE, N. Y.—A contract has been given to Hurst, Cole & Howarth at about $10,000 for building a concrete bridge with arches 63 ft. long and retaining walls 40 ft. high over the Nellis ravine in Palatine.

CINCINNATI, OHIO.—Bids are wanted November 25 by the Board of Public Service for the superstructure of a plate girder bridge over the Miami and Erie canal at Marshall avenue. G. F. Holmes is Clerk.

DONORA, PA.—The report of the viewers favors the building of the Donora bridge, the cost to be jointly shared by Washington and Westmoreland counties.

EAU CLAIR, WIS.—Bids are wanted December 7 by J. Hennessey, City Clerk, for a two-span plate girder bridge (girders to be 90 ft. over all) with a masonry or concrete substructure; also for a double-arch concrete steel bridge (arches to be 82 ft. in the clear). Bids will be received for the substructure, superstructure or for the complete bridge of either style.

EUREKA, CAL.—Bids are wanted November 15 by the Board of Supervisors of Humboldt County for building two bridges over Elk river. W. H. Haw is Clerk.

GETTYSBURG, PA.—A contract, it is reported, has been given by the United States Government to the Nelson-Buchanan Bridge Co., of Chambersburg, Pa., for building a steel

bridge over the Western Maryland Railroad at Reynolds avenue on the battlefield.

HARRISBURG, PA.—Separate bids are wanted November 22 by J. M. Shumaker, Superintendent of Public Grounds and Buildings, for rebuilding the substructure and superstructure of the bridge over Catawissa Creek in the borough of Catawissa, Columbia County, and for rebuilding the substructure and superstructure of a bridge over the same creek at Fisher's in Beaver Township, Columbia County.

MITCHELL, S. DAK.—Bids are wanted November 16 by O. D. Stearns, County Auditor, for building a steel bridge 60 ft. long with 16-ft. roadway on the county line between Davison and Aurora counties.

NEW BATTLEFORD, N. W. T.—The Canadian Northern is putting in a concrete substructure and has given a contract for a steel superstructure 1,870 ft. long, consisting of two through spans each 170 ft. and nine deck spans each 170 ft. long over the North Saskatchewan river to the Canadian Foundry Co., Ltd., of Toronto, Canada.

PITTSBURG, PA.—The Select Council, at a recent meeting, it is reported, agreed to the ordinance vacating certain streets for the use of the Pennsylvania in the Nineteenth and Twenty-first wards, in consideration of which the railroad will build a stone arch bridge over the Beechwood boulevard at Lincoln avenue at a cost of about $149,000.

SACRAMENTO, CAL.—The Board of Supervisors is having soundings made by County Surveyor J. C. Boyd to locate the site for a bridge from the mainland to Grand Island.

ST. JOSEPH, MICH.—Bids are wanted November 15 by the Bridge Committee for building a steel bridge 490 ft. long over the St. Joseph River and the Indiana, Illinois & Iowa tracks at a cost of about $22,000. Thomas A. Walker is a member of the committee.

SOUTH AUGUSTA, ONT.—Bids will soon be asked by Edwardsburg and Augusta counties for building a steel bridge on the town line between the two counties.

SPRINGFIELD, MASS.—Action will soon be taken by the County Commissioners for building the new bridge over the Connecticut river between West Springfield and Chicopee, the War Department having consented to its construction.

STERLING, ILL.—Local reports state that the War Department has ordered the removal of four bridges over Rock river, which were built without the authority of Congress.

TOPEKA, KAN.—The War Department has approved the plans for the railroad bridge to be built over the Kaw river by the Atchison, Topeka & Santa Fe.

WILLIAMSPORT, PA.—A bridge is proposed to be built over the Susquehanna River between this place and Jersey Shore.

WINNIPEG, MAN.—Engineers are locating the new Canadian Northern Railroad bridge east of Main street bridge. It will be a steel structure with concrete abutments.

### Other Structures.

ALBINA, ORE.—Bids are about being asked by the Oregon Railroad & Navigation Co. for new buildings costing about $188,000, mentioned in these columns October 28. A contract has been given by the company to George P. Nichols & Bro., of Chicago, Ill., for an electrically operated steel transfer table with concrete masonry pit, 80 ft. x 730 ft., at $10,000.

BALTIMORE, MD.—The Electric Light & Power Co., it is reported, has plans ready for building a large light and power generating station here. Land embracing about 22 acres has been bought as a site for the new power house. S. Davies, Warfield, is Chairman of the executive committee.

BRIDGEPORT, MICH.—The Detroit, Flint & Saginaw Railway, it is said, has bought a site 60 ft. long and given a contract for building a brick power house to cost about $75,000 to furnish power for its line.

BUFFALO, N. Y.—The Delaware, Lackawanna & Western is to put up a freight house and office building on the site of the abandoned Clark Skinner canal, to cost about $51,700.

DIXON, ILL.—The Illinois Central is having plans made for a new two-story stone station.

JAMAICA, N. Y.—The Long Island Railroad is having plans made for a steam heating plant.

LA JUNTA, COLO.—Work has been commenced by Charles A. Fellows & Co., of Topeka, Kan., on the new shops of the Atchison, Topeka & Santa Fe, to consist of machine shops 150 x 400 ft. and 150 x 175 ft., a power house 150 x 75 ft., a transfer table 40 x 110 ft., and a brick storehouse 75 x 120 ft., with a platform of 80 x 100 ft. An oil house will also be built and eight stalls added to the roundhouse. The entire works will be equipped with electric power. (May 27, p. 410.)

MERIDIAN, MISS.—At the annual meeting of the Meridian Terminal Co., the general plans for the new union passenger station, to cost about $250,000, were approved.

ROANOKE, VA.—The Norfolk & Western is planning to put up a new passenger station here.

ROCKWELL CITY, IOWA.—The Chicago, Milwaukee & St. Paul, reports say, has decided to build a brick and steel roundhouse.

ST. PAUL, MINN.—The Interurban Railway Co. is planning to establish shops here in place of those at Minneapolis. The buildings will cover about nine acres of ground.

SOUTH MCALESTER, IND. T.—The Choctaw, Oklahoma & Gulf and the Missouri, Kansas & Texas will jointly build a brick passenger station two stories high, 44 ft. x 171 ft. 6 in., to cost about $500,000.

YORK, NEB.—Residents of this place have petitioned the Chicago, Burlington & Quincy to build a new passenger station at a cost of about $25,000.

## RAILROAD CONSTRUCTION.

### New Incorporations, Surveys, Etc.

CEDAR RAPIDS, WATERLOO & NORTHERN.—Articles of incorporation have been filed by this company in Iowa with a capital of $100,000. The company proposes to build a railroad from Cedar Rapids, Iowa, in a northwesterly direction to Waterloo, 50 miles. L. M. Rupert is President; T. A. Berkebile, Vice-President, and E. A. Crocker, Secretary, all of Cedar Rapids, Iowa.

CHICAGO, ANAMOSA & NORTHERN.—Grading on this line has been practically completed from Anamosa, Iowa, northwest to Prairiesburg, 10 miles. The road crosses Buffalo Creek six times between Anamosa and Fremont, a distance of about five miles. Three lattice girder bridges have already been put in place and a fourth has been shipped from Milwaukee. The work of grading the line north from Prairiesburg will be continued as long as the weather permits. It is proposed to eventually extend the line to Waterloo. Henry Kiene, Dubuque, Iowa, is President, and J. F. Lacord, Anamosa, Iowa, Chief Engineer. (May 13, p. 375.)

CHICAGO & NORTH WESTERN.—According to newspaper reports, this company is now making preliminary surveys for a cut-off from Manitowoc, Wis., north through Green Bay to Gillett, 65 miles.

CHICAGO, BURLINGTON & QUINCY.—This company opened its new track between Hastings, Iowa, and Pacific Junction on Oct. 31. The Burlington now has a second track across the State of Iowa from Burlington to Pacific Junction, with the exception of three miles between Chariton and Lucas, Iowa, and about 11 miles from the top of the hill west of Hastings to Glenwood. These two sections will be double tracked next spring. The maximum grade on the new line is 35 ft. to the mile, as compared with 70 ft. on the old line. The maximum curve is 1 degree, as against 4½ degrees on the old road. The bridges and culverts are built of concrete and steel. The two largest culverts are over Sugar Creek east of Ottumwa. They are each 30 ft. wide and 22 ft. high. The work between Ottumwa and Pacific Junction was heavy, the grading averaging 120,000 cu. yds. per mile over the entire distance. The largest fill was at Grand River near Afton Junction, half a mile long and 70 ft. high. The bridge over the Grand River is 70 ft. above the river and 400 ft. long. The length of the new line, from Burlington to Pacific Junction, is 269½ miles, as compared with 276 miles by the old route, a saving of 6½ miles. (November 4, p. 147.)

DALTON & ALACULSY.—According to press reports, money has been provided for continuing the work on this railroad. About two years ago the line was graded between Dalton, Ga., and Crandall, in Murray County, 20 miles, but work was then suspended owing to lack of funds. M. S. Squires, Dalton, Ga., is said to be interested in the present plan for finishing this road. (See Construction Supplement.)

DARIEN & WESTERN.—This road has been extended from Darien Junction, Ga., to Brothers Mill, a distance of eight miles. F. H. McFarland, Darien, Ga., is General Manager. (June 10, p. 450.)

EAGLE VALLEY.—This company has been incorporated in Oregon with an authorized capital of $1,000,000. It is proposed to build a railroad from Baker City east to Richland, in Baker County, 50 miles. W. L. Vinson, John Waterman and P. Basche, all of Baker City, Ore., are named as incorporators.

ERIE.—The double tracking of the Newark branch, between Jersey City and Newark, has been completed.

GAINESVILLE MIDLAND.—According to newspaper reports, this company will soon begin work on an extension from Jefferson, Ga., to Athens, 18 miles. The Gainesville Midland was formerly the Gainesville, Jefferson & Southern. G. J. Baldwin, Savannah, Ga., is interested. (August 12, p. 57.)

GALION SOUTHERN (ELECTRIC).—Incorporation has been granted this company in Ohio to build an electric railroad from Galion southeast to Fredericktown, 20 miles, passing through Crawford, Morrow and Knox counties. W. L. Ball, M. H. Arnold and A. A. Crawford, all of Galion, Ohio, are incorporators.

GREEN BAY, OSHKOSH, MADISON & SOUTHWESTERN.—Rights of way are now being secured by this company for its proposed road from Madison, Wis., northeast to Green Bay, 150 miles. It is stated that preliminary surveys will soon be begun between these points. R. H. Hackett, Oshkosh, Wis., is said to be interested. (See Construction Supplement.)

HUTCHINSON & WESTERN.—This company has been incorporated in Minnesota to build a railroad from Hutchinson west through McLeod, Meeker and Kandiyohi counties. The authorized capital is $50,000. L. McGrory is President, W. E. Ellis, Vice-President, and C. A. White, Secretary, all of Minneapolis.

ILLINOIS CENTRAL.—According to press reports, work is progressing rapidly on the branch line from Brookhaven, Miss., to Monticello, 40 miles. It is said that this line will probably be opened for traffic before the end of the year. The contractors are Bowles & Hemingway, of Jackson, Miss., and the work is in charge of J. H. Scott, of Brookhaven, Miss. (July 29, p. 47.)

ILLINOIS, IOWA & MINNESOTA.—This company has opened it main line between Aurora, Ill., and De Kalb, 28 miles. The road will eventually be extended to Rockford, and it is stated that work on this extension will shortly be begun. H. W. Seaman, Clinton, Ill., is President, and I. W. Troxel, De Kalb, Ill., Chief Engineer. (April 29, p. 336.)

MINIDOKA & SOUTHWESTERN (OREGON SHORT LINE).—A contract has been let to the Utah Construction Co. for building this branch of the Oregon Short Line from Minidoka, Idaho, southwest through Lincoln County to Twin Falls City, 70 miles. The new road will cross the Snake River eight times. (October 28, p. 139.)

MISSISSIPPI RIVER & BONNE TERRE.—A new line known as the Hoffman branch has been opened for traffic extending from Bonne Terre, Mo., to Owl Creek, a distance of 6½ miles.

MISSOURI, KANSAS & TEXAS.—According to press reports, this company has let a contract for building an extension from Oklahoma City, Okla. T., to Wichita Falls, Tex. The same report goes on to say that three routes are being considered, one from Oklahoma City to Wichita Falls, one from Shawnee to Wichita Falls and the other from Guthrie to Wichita Falls, but that the former route will probably be the one accepted.

PEACH RIVER & GULF.—The charter of this company has been filed in Texas with an authorized capital of $100,000. It is proposed to build a railroad from Willis, in Montgomery County, Texas, to Beaumont, a distance of about 100 miles. The general offices of the company will be located at Timber, Tex. A. W. Miller, R. W. Smith, C. C. Moore, all of Galveston, Tex., and M. M. Riner, Timber, Tex., are named as incorporators.

PITTSBURG & ALLEGHENY VALLEY (ELECTRIC).—A contract has been let to Southurst, Allen & Baker, of Philadelphia, for building this proposed electric road from Oakmont, in Allegheny County, Pa., southeast to Blairsville, in Westmoreland County, 30 miles. The work will cost about $1,000,000.

ROCHESTER, SYRACUSE & EASTERN.—An officer writes confirming the report that a contract has been let to J. G. White & Co., 49 Exchange Place, New York City, for building sections 4 and 5 on this road from Palmyra, N. Y., to Newark. Grading is now in progress on section 1 from Rochester to Fairport, by the contractors, F. T. Ley & Co., Springfield, Mass.; and on sections 2 and 3 from Fairport to Palmyra by the J. Shields Construction Co., of New York. Track laying will be begun early in the spring and the company hopes to have the road opened for traffic between Rochester and Lyons, 36 miles, by November, 1905. T. H. Mather, Syracuse, N. Y., is Chief Engineer. (September 23, p. 103.)

SOMERSET RAILROAD.—Bids are asked until December 1 for building nine miles of railroad, including 110 acres of clearing, 70,000 cu. yds. of earth excavation, 9,000 cu. yds. of loose rock, 12,000 cu. yds. of solid rock, 800 ft. of pile bridges, 200,000 ft. of timber culverts, and the necessary track laying. W. M. Ayer, Oakland, Me., is Manager, and J. F. Hill, Bingham, Me., is Chief Engineer. (September 9, p. 87.)

TEXAS ROADS.—A charter has recently been granted to the San Saba Construction Co., with a capital of $1,000,000. The principal office of the company will be located at Abilene, Texas, and it is reported that the company is to build a railroad from Abilene to Llano, a distance of about 200 miles.

UNION PACIFIC.—An officer writes denying that this company has let a contract for building the proposed line between Menoken, Kan., and Marysville. Surveys for this line were completed a short time ago. (October 28, p. 140.)

VIRGINIA & SOUTHEASTERN.—A charter has been granted this company in Virginia with an authorized capital of $10,000,000. It is reported that the company has been incorporated in the interest of the Virginia Iron, Coal & Coke Co. to build a railroad which will afford an outlet for its products. According to local press reports, the road will run from a point on the Tennessee and Virginia state line through the counties of Lee, Wise, Scott, Dickenson, Russell, Washington, Smyth, Tazewell, Bland, Giles and Wythe, about 300 miles. G. B. Schley, 80 Broadway; H. K. McHarg, 40 Wall street, New York; D. D. Hull, Jr., Bristol, Va., and others are named as incorporators.

## RAILROAD CORPORATION NEWS.

ATLANTA & WEST POINT.—The report of this company for the fiscal year ending June 30, shows gross earnings of $853,647, an increase of $45,375. Operating expenses were $511,246, an increase of $24,771, leaving an increase in net for the year of $20,501. The ratio of operating expenses to earnings was 59 per cent., as against 60 per cent. in 1903. The increase in gross receipts was largely due to a gain in passenger earnings, which were unusually heavy.

COLUMBUS, DELAWARE & MARION.—This company has been incorporated in Ohio with a capital stock of $2,500,000. The new corporation will be the holding company of the Columbus, Delaware & Marion Electric, capital $1,666,000; Marion Railway Light & Power Co., capital $500,000, and the Columbus Northern Railway Power & Equipment Co., capital $300,000. J. M. Webb, Springfield, Ohio, is President; M. J. Catrow, Miamisburg, Ohio, Treasurer, and Walter Black, Columbus, Ohio, Secretary of the holding company.

DES MOINES & FORT DODGE.—Holders of the $3,072,000 bonds maturing Jan. 1, 1905, are notified that the bonds will be paid on and after Jan. 3, 1905, or they can be exchanged for the new 4 per cent. first-mortgage bonds which were recently authorized by the company. The new bonds are dated Jan. 1, 1905, and are a first mortgage on the entire property. They are guaranteed by the Minneapolis & St. Louis. A large portion of the new bonds have already been disposed of at private sale. (October 21, p. 134.)

GREAT NORTHERN (CANADA).—The plan of reorganization of this company has been agreed upon. The plan provides for an issue of $4,660,000 new first-mortgage 4 per cent. bonds, guaranteed principal and interest by the Canadian Northern. The proceeds from the sale of these bonds will be used to pay off a floating debt of $500,000 and to refund the 5 per cent. bonds now outstanding. The plan also provides for consolidating all the subsidiary companies and paying off all liens. (August 26, p. 74.)

LINDSAY, BOBCAYGEON & PONTYPOOL.—This company, which is leased to the Canadian Pacific for 99 years from July 1, 1903, has filed a mortgage with the National Trust Co., of Toronto, Ont., to secure an issue of $700,000 first-mortgage 4 per cent. bonds. These bonds are dated July 1, 1903, and are due July 1, 2002, with option of earlier redemption. The mortgage covers all the property of the company and its income, including a guaranteed rental at the rate of $20,000 per year. It is stated that $500,000 of these bonds will be placed on the market at once.

MISSOURI, KANSAS & TEXAS.—At the annual meeting of the stockholders of this company on November 2, a supplemental mortgage to the first refunding mortgage of $40,000,000 recently authorized by the directors was ratified and confirmed. The proceeds from the sale of this mortgage will be used for refunding purposes, for new rolling stock and other expenses.

NEW YORK CENTRAL & HUDSON RIVER.—J. P. Morgan & Co. announce that they have sold the balance of the $30,000,000 four per cent. debenture bonds of this company bought last June.

NEW YORK, PHILADELPHIA & NORFOLK.—This company has declared the regular semi-annual dividend of 3 per cent. and an extra dividend of 2 per cent., both payable on December 1. This makes a total of 8 per cent. for the calender year 1904, as against 6 per cent. in 1901 and 1903, and 5 per cent. in 1902.

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## EDITORIAL ANNOUNCEMENTS:

*THE BRITISH AND EASTERN CONTINENTS edition of the Railroad Gazette is published each Friday at Queen Anne's Chambers, Westminster, London. It consists of most of the reading pages and all of the advertisement pages of the Railroad Gazette, together with additional British and foreign matter, and is issued under the name, Transport and Railroad Gazette.*

*CONTRIBUTIONS.—Subscribers and others will materially assist in making our news accurate and complete if they will send early information of events which take place under their observation. Discussions of subjects pertaining to all departments of railroad business by men practically acquainted with them are especially desired.*

*ADVERTISEMENTS.—We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay,* EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and these only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers, can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially either for money or in consideration of advertising patronage.*

FRIDAY, NOVEMBER 11, 1904.

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